ELECTRICAL REVIEW

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

(*Formerly Review of Telegraph and Telephone.*)

Vol. 4, No. 8. WEEKLY. | NEW YORK, SATURDAY, APRIL 26, 1884. | $3 per Annum. Single Copies, 10 Cents.

Copyright, 1883, by DELANO & COMPANY, 23 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

Electric Batteries and Accumulators at the Vienna Exhibition.

The batteries, although they were rather numerous at the Vienna Exhibition, did not represent anything very special, and were, for the most part, models which had been known for a long time previously.

M. Gaston Planté exhibited a beautiful collection of the apparatus he has produced for the accumulation and the transmission of voltaic electricity. There was found his secondary couple of 1860, accompanied with models properly fitted to show the manner of their construction and electro-chemical formation. The capacity of those well-formed couples was substantially represented by one specimen of galvanic copper produce in a voltameter, by means of a single discharge, and weighing nineteen grammes for one kilogramme of the lead of the secondary couple, which corresponds to 57,000 coulombs or thereabouts.

There was also a battery of six couples illuminating three incandescent lamps. Then a model of small battery of twenty couples, charged in quantity and discharged in tension, of the same system as those used by Mr. Planté for his experiments on the high tension electrical currents. Further, a portable electric lantern, composed of two secondary

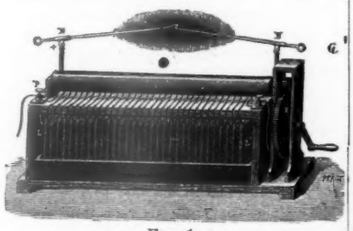


FIG. 1.

couples and an incandescent lamp. The electric lighter, formed of one single secondary couple of leaden plates, called "Briquet de Saturne;" sundry specimens of electrical engraving on glass, etc., etc.

The rheostatic machine, projected by Mr. Planté in 1877 (see Fig. 1), was represented in operation at the Vienna Exhibition. Four small secondary batteries, composed each of eighty couples with leaden wires, forming in the aggregate an accumulation of 320 couples, kept loaded by three small elements with sulphate of copper affixed to them (see Fig. 2). When these batteries were connected with the rheostatic machine, the current would distribute on all the conductors with mica plates, and when the apparatus was put into rotary motion, a series of continuous sparks about one inch in length was obtained. By approaching a Leyden jar to one of the poles of the machine, the other pole in communication with the external armature of the jar would become charged, and the sparks were shorter, but more intense and blusterous.

Thus could have been verified one of the most curious results described by Mr. Planté his "researches on Electricity," by ascertaining that after a few seconds of acting of the primary pile upon the batteries, more than ten thousand sparks could be produced by the rheostatic machine. It could, moreover, be ascertained, by weighing the copper deposited in the primary pile during those few seconds, that the production of those thousands of sparks, easily counted by the number of revolutions of the commutator of the machine, corresponded with the expense of a few milligrammes of zinc in the pile, and that the least electro-chemical effect could thus be appreciated in a measured and visible manner by the number of sparks of statical electricity produced.

The results attained by means of a rheostatic machine of larger size were illustrated under the form of tables representing the traces of sparks, five inches in length, on flour of sulphur, with the various branchings, sinuous and crooked courses of such traces, and some very remarkable arborizations showing the special characters of positive and negative electricity.

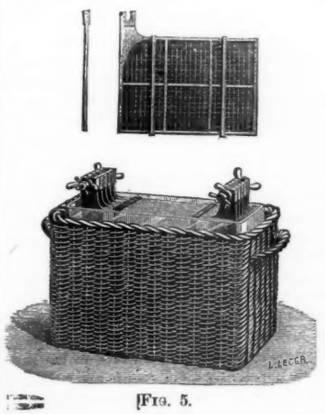


FIG. 5.

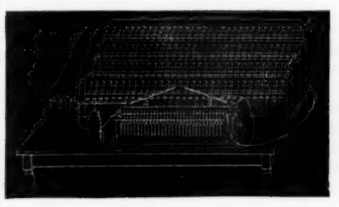


FIG. 2.

Alongside the Planté's pile we must notice further, besides the well-known apparatus of Messrs. Faure, Sellon and Volckmar, several models of accumulators.

In those of Messrs. Arnould and Tamine —Fig. 3—the formation is made directly by the current, as in the Planté's pile; but the plates are formed of horizontal wires connected at their extremities by autogene soldering. Those plates are kept separate, either by being fitted in the vat at both ends into grooves practiced in parafined wood, or else by separating them by strips of tarred wood.

In the electro-clock of Messrs. Barrier and Tourville—Fig. 4—the plates are formed of concentric leaden tubes fitted into a wooden cover. Those tubes are grooved, inside and outside, and the furrows produced by such grooving are filled with a special cement composed of litharge, powdered charcoal and permanganate of potash; the whole of it having first been properly triturated, well-mixed in a sieve, then mingled with glucose or sugar syrup, so as to reduce it in a paste. That mixture forms a very adhesive cement, both before and after it has been submitted to the electrolytic action.

We will also mention the accumulators of Mr. Kornbluk—Fig. 5; the plates of this apparatus are composed of leaden grate with grooves, between which is stamped with a press a special preparation of minium, which, after 18 hours of formation, constitutes a compact mass with the lead.

The ends of the plates are widened so as to touch each other, while they maintain the plates at proper distance, they are, moreover, indented in such a manner as to admit a thumb-screw nut, provided with a counter-

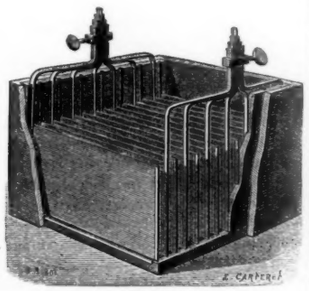


FIG. 3.

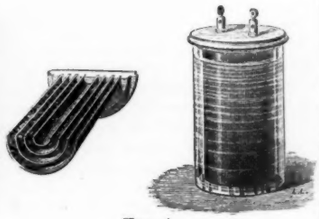


FIG. 4.

screw nut, by the means of which they are tightened together. The plates themselves are, moreover, kept separate by india-rubber bands. The glass vessels are placed in willow baskets.—*La Lumiere Electrique.*

Electric Propulsion for the New York Elevated Railroads.

In our edition of March 6th we published an able article from Thomas Whiteside Rae, C. E., on the above subject, which elicited the following criticism from our esteemed contemporary, the *Railway Gazette*, which we republish herewith, together with Mr. Rae's reply thereto:

The *Gazette* says that "the conclusions of the writer, if correct, would be a matter of much congratulation. The substitution of electric motors of the same tractive power, but of only half the weight of the present locomotives, would in itself be a boon which might best be utilized by employing motors of the same weight as the present engines, but of double the power, and conveying trains of double the present seating capacity. Provision would thus be made for the inevitable growth of travel, and the present inconvenient crowding of the cars during the busy hours of the day would become a thing of the past. But, unfortunately, the present state of electrical science, as applied to railroad propulsion, is not favorable to the realization of these anticipations. The greater cost of electricity forbids its employment, in spite of certain obvious advantages. Our correspondent arrives at opposite conclusions, for the simple reason that he both underestimates the power required under the present system, and the cost of generating this assumed, but insufficient amount of power by the stationary engines and dynamos he proposes to employ.

"A continuous gradient of 60 feet to the mile is nearly equivalent to a resistance of 23 lbs. per ton, and, adding to this 8 lbs. per ton for all other sources of resistance, the total resistance becomes 31 lbs. per ton, or nearly four times that assumed by Mr. Rae. The annual report of the Manhattan Company (see page 755 of our last volume) shows that the average train may be taken at 3.75 cars containing about 120 passengers. The average weight of the cars is about 23,850 lbs. each, and the weight of the whole train would be about 152,000 lbs., or 76 tons. The consequent average resistance to be overcome by each engine would therefore be 76×31, or 2,356 lbs., instead of 547 lbs., as assumed by Mr. Rae. Accepting, for the sake of argument, his figures as to the number of engines simultaneously in motion, the total average power exerted at any one time by the engines at work on the elevated railroad is somewhat over 12,500 indicated horse-power. A similar power would have to be exerted by the proposed electric motors, and to allow for loss a still greater power must be exerted by the stationary engines driving the dynamos that actuate the motors.

"In a small electric railroad constructed by Messrs. Siemens & Halske, of Berlin, Germany, it has been found from careful observations that the ordinary steam engine has to exert more than three times the amount of power developed by the electro-motors. Professor Oliver Lodge states that 'the net power obtained at one end is necessarily always rather less than 50 per cent. of the gross power applied at the other end. If the insulation is bad, it may be very much less.' It would, therefore, appear that stationary engines, capable of exerting 50,000 indicated horse-power, would not be a whit too powerful to work an electric railroad where the power to be exerted by the electric motors averaged 12,500 indicated horse-power, and where the maximum power required might considerably exceed that figure.

"The annexed table shows roughly the effects of these essential modifications in Mr. Rae's sanguine estimates as to the cost of gigantic engines and engine-houses. The estimate for the central rail is increased, as Mr. Rae forgot to allow for the double track

or for sidings. It is, moreover, doubtful whether a 35 lb. iron rail would be sufficient to convey the requisite amount of current; probably a larger and infinitely more costly copper conductor would be necessary. A 19 lb. rail, most carefully insulated, is used on the Giants' Causeway line, where the stationary power driving the dynamo can only rise to a maximum of 120 horse-power. As the power to be conveyed is at least 40 times greater on each line of rails, it would be well to allow a conductor at least 20 times as heavy.

"The extra capital for plant necessary to equip the New York elevated railroads for electric propulsion would be as under:

	Amended estimate.	*Original estimate.*
Stationary engines, 50,000 I. H. P.	$2,000,000	$270,000
Generating dynamos, 56,000 I. H. P.	1,093,000	273,375
Two station-houses, each 225 feet square	700,000	50,000
227 electric motors, at $12,000	2,724,000	681,000
80 miles of central rail.	1,100,000	40,000
Total	$7,617,000	$1,314,375

"The transmission of large powers by any known forms of electrical contrivances first set in motion by a steam-engine practically amounts to an extravagant outlay in plant, wages and fuel. Taking this particular case, the electric motors have to exert about the same power as the locomotives. The dynamos have to supply each motor with an excess of power to allow for loss in the motor, which can only utilize a certain percentage of the power it receives. The stationary steam engines have to supply the dynamos with more power than the latter in their turn give the motors. The employment of steam power attached directly to the train avoids these losses, caused by the employment of intermediaries. The only possible saving is to be found in the smaller consumption per indicated horse-power of the condensing steam engine employed. This saving, however, is far smaller than supposed by Mr. Rae. An appreciable amount of steam is consumed in applying the brakes and in heating the cars; and instead of 28 lbs. per indicated horse-power, the consumption is probably between 4 and 5 lbs. The best marine engines burn as little as $1\frac{5}{8}$ lbs., and experiments in France, recently published in the *Railroad Gazette*, show a consumption of 2.88 lbs. on locomotives. Assuming that the condensing stationary engines employed were of a marine type, and worked as economically, they would burn about 1 lb. per indicated horse-power less than an economical locomotive worked under favorable conditions. A locomotive working a train making frequent stops has, however, to work with the lever well forward; and, constantly, the small amount of expansion increases the consumption of fuel, and, therefore, the difference may rise to 2 or 3 lbs. This saving is, however, wholly swallowed up by the greater power which the stationary engines would have to exert. Thus, if the locomotives at present indicate 12,500 horse-power, and burn even as much as 5 lbs. per indicated horse-power, the gross consumption is 62,500; while if the stationary engines exert 40,000 horse-power as an average, and burn but $1\frac{5}{8}$ lbs., the consumption is 65,000 lbs. In other words, in this case the locomotive, taken at its worst, is more economical than the stationary engine taken at its best. The latter, moreover, would require a large supply of condensing water, which is both expensive to procure and difficult to cool or dispose of in a crowded city.

Electric propulsion would therefore entail extra outlay in coal, water and plant, while an extra number of men would be required to work the stationary engines, boilers, and dynamos, and attend to the insulation, etc., of the central rail. Though the electro-motors would require no firing, the engineer would still need an assistant in switching, oiling, etc., and especially in aiding him to keep a sharp lookout on both sides when rounding curves, or in foggy weather. The repair staff would probably be not only larger, but more highly paid. The whole power being concentrated in six stationary engines the simultaneous breakdown of two engines while a third was under repair would materially impair the efficiency of the whole system. This is no unlikely contingency, as is proved by a recent case where powerful condensing engines are used. A well-known Atlantic steamship company employs six regular steamers While one was undergoing repair, two others broke down in quick succession. While, however, the steamers would proceed at slow speed under sail, the electro-motors, deprived of current, would be absolutely helpless.

"An electric railroad in the present condition of the art can only become commercially practicable where a natural source of power, such as a waterfall, can be easily and cheaply utilized. The only electric railroad of any size hitherto constructed, that near the Giant's Causeway, Ireland, derives its power from a turbine driven by a mountain torrent; but even the late Sir William Siemens, the moving spirit of the enterprise, did not give one the idea of being sanguine as to its economic success, even if practical difficulties as to details would be successfully overcome. The locomotive has still a career of useful work before it, in spite of Mr. Rae's very sanguine views as to the economy of electric propulsion.

AUTHOR'S REPLY TO FOREGOING REVIEW OF "ELECTRIC PROPULSION."

Pray accept my thanks for the exhaustive review of my article upon the application of electric propulsion to the elevated railroads of New York city.

While I must dissent generally from your strictures, I admit their justice in one or two particulars, and am especially gratified that my views should have appeared of sufficient importance to merit the attentive consideration they have evidently received. If you will grant me space to reply to some of the exceptions I shall count myself uncommonly fortunate.

You seem to have no objection to the method of reasoning, but conceive that my conclusion is reached through the adoption of erroneous values; or, in your own words, underestimating "the power required under the present system, and the cost of generating this assumed, but insufficient, amount of power by the stationary engines and dynamos."

Your epitome of my original communication gives the gist of it—although co-efficients of traction of 0.004 and 0.006 are nearer 9 and 13.5 than 8 and 12 lbs. per ton—and the first point on which I would join issue is the assertion that the measure of maximum work performed by a locomotive is the effort exerted in putting a train in motion. The fallacy is a most plausible one, but not difficult to be proved a fallacy.

Mechanical work consists of force and distance—pressure and space—and in the absence of either factor no work is accomplished. No amount of pressure will create work until motion ensues, and it is an absurdity to impute horse-power to a quiescent locomotive. The boiler pressure may increase to the limit of safety, and the pull of the locomotive be never so great as at the instant before motion is established, but up to that moment no exterior mechanical work has been performed, as the space-factor is zero. With the inception of motion the pull of the locomotive—or co-efficient of traction—tends to assume its normal value; the space-factor is measurable and horsepower may be calculated, but not until then. Further, the work then performed is the totality, and such are the only conditions in which work is possible. The product of the diminished motion of the pistons, before the train has gathered way, and the accumulated boiler pressure, is an equivalent to the rapid motion and reduced pressure when the normal train speed is established. Does combustion go on faster when a locomotive is standing still? Rather the reverse.

In view of my position on this point it becomes unnecessary to analyze your calculations or to comment on the reasoning which leads you to compute the "total average power exerted at any one time by the engines at work on the elevated railroads" at "somewhat over 12,500 horse-power." There is no common premiss to argue from.

If your theory is correct, it concedes an immense advantage to electric propulsion, which Sir William Siemens thus indicates in his description of the Berlin Railway: "It is a remarkable circumstance in favor of the electric transmission of power that while the motion of the electro-magnetic or power-receiving machine is small its potential of force is at a maximum, and it is owing to this favorable circumstance that the electric train starts with a remarkable degree of energy."

I note one patent error that you have adopted, which is attributing a speed of 30 miles per hour to the elevated trains in question; the maximum is rarely 20. You also have misapprehended the principle of my elimination of the influence of grade in calculating the total work of moving them.

I do not assert that "undulating grades make no difference in the average resistance or coal consumption"—although it is not an extravagent surmise that a locomotive could be so manipulated as to compass such a result—but that where a number of trains, all deriving their motive power from one source, and each one receiving power in strict proportion to its load, are running, half in one direction and half in other, over the same grade, its influence upon the total work done is neutralized.

If the contrary is true with steam locomotives electric propulsion may score again in the competition, as Siemens says of it, in discussing the inter-action of prime and counter currents; "If two trains should be placed on the same pair of rails, the one moving upon an ascending portion, the other upon a descending portion of the same, power would be transmitted through the rails from the latter to the former, and the two might therefore be considered as connected by means of an invisible wire rope."

Your data as to the number of cars in the average train and the average number of passengers carried per train vary somewhat from those supplied to me, and seem to be more exact and to cover a longer period of observation. I will therefore substitute them in my calculation of average work; and since my comparison was between the average, as performed by steam locomotives, and the maximum that could by any chance be demanded of electro-motors, I will take the maximum train-load at 4 cars carrying 400 people 20 miles per hour—which is a remote possibility—and revise my estimate both of average and maximum work accordingly.

Your record of efficiency of the electric railway at Berlin differs materially from mine, wherein I find that the 5 horse-power steam engine driving the generating dynamo produced nearly 3 horse-power on the rails. Sir William Siemens in describing this road stated that "more than 50 per cent. of the power of the stationary engine is actually utilized," and Werner Siemens says: "It is perhaps merely a question of size and velocities of the driving and driven machines whether a still higher percentage of power may not be regained."

When it is considered that four years of experiment and improvement have elapsed since the building of this line, the statement of Professor Lodge, viz., that "the net power obtained at one end is necessarily (*sic*) rather less than 50 per cent. of the gross power applied at the other end—if the insulation is bad it may be very much less," becomes the more unintelligible. The only foundation for such an assertion that I can imagine might possibly be found in the experiments of the Siemens Brothers, which showed that the percentum of work reclaimed was at a maximum when the speed of the receiving was about $\frac{1}{10}$ of that of the generating dynamo.

Your assumption, then, that only 25 per cent. of the original power can be reclaimed—or what is the same thing, that stationary steam engines of 50,000 horse-power are needed to produce 12,500 horse-power on the rails—seems to be without reasonable basis.

You have convicted me of one piece of carelessness, however, which is unpardonable, viz.: overlooking the fact that the 32 miles of elevated track in New York is double instead of single; and I accept your figure for the amount of central rail necessary—although it strikes me as excessive—and will amend my estimate accordingly.

In view of your doubt of its sufficient size, I am quite willing to substitute a 56-lb. for a 35-lb. rail, but not so much from electrical necessity as for the convenience and economy to which uniformity in the *materiel* of an engineering structure conduces. For example, the interchangeability would permit of using worn-out line rails for conductors.

Some such consideration evidently led to the adoption of a 19-lb. rail at Port Rush, and the assumption that it was proportioned to the electrical requirements of that case is responsible for the erroneous conclusion you arrive at respecting the proper size of conductor for the case in question.

The elevated roads offer such exceptional facilities for insulating the conducting rail that any augmentation for loss of current would be farcical. I am confident that it could readily be kept within 1 per cent. in a distance of 20 miles.

Your figures for the efficiency of marine engines—viz., $1\frac{5}{8}$-lbs. of coal per horse-power—may possibly be attained under special circumstances, but I venture to assert that in the conditions of actual practice the same engines would consume nearer 3 than 2 lbs. of coal per horse-power.

As for a locomotive developing a horse-power for 2.88 lbs., I imagine it will be as startling to the profession generally as it was to me, and give rise to much conjecture whether such a result was derived from a laboratory experiment or in actual service.

If such locomotives can be had my argument is seriously impaired, and, moreover, the management of our elevated roads is placed in a dilemma, one of whose horns is utter imbecility, and the other criminal negligence. To ignore the existence of such machines convicts it of one or the other. It seems more reasonable to assume that it makes the best of rather difficult conditions.

Concerning your prognostication of the cost of attendance in a system of electric propulsion, all that can properly be said is that experience alone can decide the matter. It is not out of place, however, to submit that a system which readily lends itself to the maintenance of lights brilliant and penetrating enough to pierce any fog precludes the necessity of a special lookout on the motor; and also that the liability to accident of marine machinery affords no parallel for similar contingencies with stationary engines.

Recapitulating, the exceptions of the arguments which I admit are, viz.:

That the maximum train should be increased from 3 to 4 cars, and its speed from 13.5 to 20 miles per hour.

Also, that the average train be increased from 3 to 3.75 cars, each carrying 32 instead of 25 persons.

Also, that the quantity of central rail be increased from 32 to 80 miles, and its weight from 35 to 56 lbs. per yard.

Correcting my first published results—both maximum and average—with reference to them, I find the total horse-power that could be possibly called for to be about 10,000; and that each locomotive exerts at an average 22 horse-power, at a cost of 23 lbs. of coal per horse-power per hour.

It is only just to say that the substitution of electro-motors of half the weight of steam locomotives would reduce the total work required of the stationary generators about 10 per cent., although no advantage is taken of the fact in the comparison.

Another fact bearing upon it, which has come to my knowledge since the first communication was published, is that only 6 per cent. of the total equipment of the elevated railroads is ever idle, and, therefore, that 213 locomotives may be considered as under steam continually.

Exception has been taken—and I think justly—to the cost of the power station at the Battery; but if it be too small for that locality it is sure to be large enough for West 59th Street, where it may just as well be established, so far as engineering requirements go, although its upper stories would not be so desirable for company offices as they would in the first-mentioned situation. Furthermore, the power station at 129th Street might be erected at 96th Street on ground already owned.

The tabular statements, revised in conformity with these exceptions, will then read as follows:

COST OF MOTIVE POWER PER HOUR WITH STEAM LOCOMOTIVES.

Interest upon and depreciation of 227 locomotives @ $6,500, at the rate of 15 per cent. per annum	$25 26
Wages of attendants for 227 locomotives	47 30
Total coal @ $3 per ton for 213 locotives, developing 22 H. P. each @ 23 lbs. per H. P.	144 00
Total per hour	$216 56

COST OF ELECTRIC INSTALLATION EQUIVALENT TO PRESENT MOTIVE EQUIPMENT.

10 stationary steam engines, 2,000 H. P. each, with boilers, costing, inclusive of erection	$500,000
16 generating dynamos, each 1,250 H. P. capacity, inclusive of erection	506,000
1 station-house at East 129th Street, for the Second and Third Avenue lines	20,000
1 ditto at Battery for the Sixth and Ninth Avenue lines	30,000
227 electro-motors @ $3,000	681,000
80 miles of central rail, 56 lbs. per yard, laid	142,000
Total	$1,879,000

COST OF MOTIVE POWER PER HOUR WITH ELECTRIC INSTALLATION.

Interest upon and depreciation of installation at the rate of 10 per cent. per annum	$21 49
Total coal @ 2 lbs. per H. P. and $3 per ton	53 62
Labor at power stations: 2 chief and 4 assistant engineers @ $22 per diem, 74 strokers @ $148 per diem	7 08
Wages of 1 attendant per motor, 227 @ $3 per diem	28 38
Total per hour	$110 57

To sum up, the ratio between the cost of electric propulsion and steam locomotion is about as 1 to 1.96; or $1 will obtain as much work by the former as $1.96 will by the latter.

Did space permit, I would cite some expressions of Sir William Siemens concerning the future of electric propulsion, which certainly foretell great things. His views enlarged greatly as his investigations continued and you must have in mind some of his earlier opinions when you impute to him a doubt of its economical utilization. He believed this to be close at hand, if not already arrived.

Let me say, finally, that I would be judge rather than advocate in this case, and am ready to entertain any exception that is taken with a fair showing of relevancy; but at present I am aware of none—nor do I suspect the existence of any—which would materially affect the stated result. The data of performance of the elevated roads came from official sources, and the quotations of expert opinion give the *thoughts* of the speaker at the time of utterance—not only his *words*—as faithfully as isolated sentences can.

In conclusion, I deprecate any intention of inaugurating a crusade against steam locomotives, and urge that my argument be considered strictly within the circumscribed limits to which it is confined, viz., the applicability of electric propulsion to the elevated railroads of New York City.

THOMAS WHITESIDE RAE, C. E.

Atmospheric Electricity.

APPARATUS FOR MEASURING ELECTRICITY IN THE AIR.

During the fall of 1882 the United States Government, through Secretary Frelinghuysen, sent Professor Henry Rowland, of Johns Hopkins University, and Professor John Trowbridge, of Harvard College, to represent the United States at the conference of electricians held in Paris at that time. One of the questions brought before the conference, and which received special attention, was that of "atmospheric electricity." The representatives of the United States were prominently identified with the discussion which then took place, and were selected by the conference as a committee to further investigate and report. It was proposed to have a series of observations taken in different parts of the world, and, through the cooperation of the different nations, it was hoped much would be accomplished. More particularly was the question as to the value of such a knowledge for meteorological purposes brought up, and, on the return of Professor Trowbridge, at the request of the United States Signal service, a beginning was made.

It is now over a year since the first observations were made, and the work has been steadily continued. The purpose of the work was to get some measurement of the changes in the electricity of the air, constantly going on. The method employed was what is known as the Thomson method (after Sir William Thomson, the greatest authority on electro-statics). The apparatus employed is exceedingly expensive and delicate, and in some of the instruments actually used the nicety of adjustment is so fine that a millionth part of the charge of the smallest distilled water-cell is easily measured. The opening of a door in a far-off corner of the building is sufficient to instantly deflect a delicately-suspended aluminum needle seven or eight inches, and the approach of a person in the neighborhood of the apparatus would upset everything. A fine stream of water is kept constantly dropping from a metallic nozzle, which is insulated and placed at the point in the air the electrification of which is to be determined. This insulated nozzle is connected with one set of quadrants in a Thomson quadrant electrometer, while the other set of quadrants is connected with the ground. Between the upper and lower surfaces of the four quadrants, and running diagonally, is suspended by two spider-lines a figure "eight"-shaped needle, made of aluminum. This is connected with a fine platinum wire, which dips into a jar of pure sulphuric acid, the outside of the jar being carefully covered with tinfoil. The needle also carries a small concave mirror about the size of a gold quarter-dollar. A fine beam of light from a distant gas flame is reflected from the mirror upon a prepared sheet of sensitized paper, and the record of any change in the place of the needle is thus obtained by photography. A very fine battery of 144 cells—probably not equaled elsewhere—is kept connected with a charging point attached to the jar, and the needle is thus constantly charged and responds at once to the slightest variation in the electric condition of the neighborhood.

This is the principle of the operation. In practice it took almost six months of patient, hard work to make the apparatus and the proper adjustments, and special means had to be adopted and originated. The apparatus in use has several new points in its arrangement that will undoubtedly be of great value for future work. A continuous photographic registration of changes in the electricity of the atmosphere has never previously been attempted in this country, and has only twice ever been attempted elsewhere—once at Kew, under Sir William Thomson and Balfour Stewart, and a year ago or so at Paris, by Mascart, director of the bureau. While both of these attempts attracted great attention from the scientific world, and have yielded good results, it is believed that the arrangement at Harvard is superior in many points. As a specimen of the value of these electrometrical records to the ordinary reader, it is stated by Professor Trowbridge's assistant, Mr. Alexander McAdee, of the Signal Office, that a change in the direction of the wind is often indicated several hours, frequently four or five, in advance, by a change in the state of the electrical potential of the air. Rainy weather and coming storms are also foretold by the changes, but the observations are not yet full enough to lead to any decided statements. Observations are also being made with a view to determining what influence altitude has on the electric charge of the air, and instruments have already been placed on the top of the new physical laboratory. It is a work of great delicacy, and some time must necessarily elapse before the great mass of results can be worked up. It seems, though, to be the coming thing for indicating changes in the weather. It has already given good evidence of its ability to foretell changes, not only in the direction of the wind and of the humidity of the air, but also of the other more involved factors which must be taken into account in forecasting the weather. The idea of using it in connection with weather forecasts is entirely original in this country. A duplicate arrangement has already been set up, using a fine Thomson attracted disc electrometer, for the purpose of comparing the electric condition of the air at a distance, and it is expected that, in a short time, the Signal Department will set one up in Boston for practical use.

The Electrical Exhibition Buildings in Philadelphia in Progress of Erection.

The work of erecting the buildings for the coming electrical exhibition is progressing rapidly. The site of the buildings is the vacant lot of the Pennsylvania R. R at at Thirty-second and Market streets, Philadelphia, and great piles of lumber have been placed there, and are under the operations of the carpenter's saw and chisel. The structure is to be completed by the first of June, and the contractor takes advantage of the good weather to employ a large force of workmen. The ground has been drained and the whole of it floored. The flooring planks are well covered with pitch on the under side for preservation. A number of the spans of the three arches of the main building have been constructed, and derricks are in readiness to erect them in their position. In the 1,500 exhibits which the building will contain, will be represented nearly every country in Europe, and by the applications for space, it may be observed that the electricians of France, Germany and Belgium are taking great interest in the event. The Belgian government will make a historical exhibit of the advances made in the science of electricity in that country. The Lighthouse Board will display the illumination of beacons with electricity, and the Board of Engineers of the War Department will illustrate the use of the electric search light (for torpedoes) in the Schuylkill river. It is not yet known whether facilities can be given for making this display. Colonel Banes, of the Institute, is in Washington, and will confer with the Board of Engineers in order to ascertain precisely what will be necessary for this display in the way of space in the river and access from the shore. The managers have received an application from the Edison Company for 1500 square feet of space, and the United States Electric Lighting Company ask for sixty-horse power. Other large companies have entered their names upon the roll of exhibitors. The Institute contemplates the formation of a library, to be called "The Memorial Library of the International Electrical Exhibition." This library is to be as complete a collection as possible of all publications, new or old, pertaining to electrical science of this and other countries. It is to be a part of the exhibition, and afterward will be placed in the Institute as a permanent memorial of the state of electrical science at the time it is made. A committee was appointed on this subject. It has prepared a handsome paper setting forth the above intentions. It will be printed in six or seven different languages, and mailed to all parts of the world, asking contributions, and stating that the donors will be given full credit for them in a printed catalogue of the collection.

Planning an Electrical Exhibition.

Ex-Mayor Hildreth, President of the Mechanics' Association, and Dr. W. H. Raymenton, President of the Natural History Society, of Worcester, Mass., arrived in this city on Friday of last week. They came to arrange the details of an exhibition of the latest inventions and improvements in electrical science, to be given under the auspices of their societies in Exhibition Hall, Worcester, May 1 and 2. Dr. Raymenton said to a *Tribune* reporter: "The committee is accompanied by a number of prominent Worcester gentlemen, among whom are Ex-Senator Bates and Stephen Salisbury, Jr. Our mission has met with gratifying success. Mr. Edison has promised his co-operation, and his company will supply us with all the material for our extensive display of its system of electric lighting. Mr. Edison will also make special exhibit and application of his electric motors, and will himself personally attend our exhibition. We hope to enlist the co-operation of the other companies, as we desire to make the exhibition the most complete and extensive that has ever been given in New England. Our time is short, but we have abundant means, and are certain of the interest and support, not only of our own townspeople, but also of many in the surrounding towns."

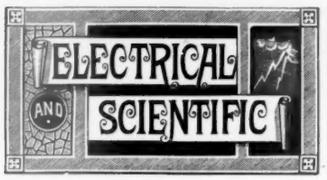
Electricity for Lighthouses.

It is strange that, with the many and increasing uses of the electric light, there has not been a demand for its adoption in the lighthouses of the coast and lakes. The brilliancy and power of the electric flame is such that from the proper height its glare would penetrate almost any mist or fog and greatly contribute to the safety of vessels. The Daniel Steinmann went ashore near Sambro Light because the fog was so thick that the light was not seen until too late. Had there been an electric light on the Sambro tower it could have been seen through the mist for at least three or four miles, and the captain of the ill-starred ship would have recognized his danger.

It is possible that under the present system of generating light by electricity the expense of supplying individual lighthouses might be greater than now, but, even if it should cost ten times as much, what would that be as compared to the safety of one shipload of lives? Many of the light towers would require separate plants, but not all. At nearly all the large cities on the coast and on the lakes they could be connected with the local machines at small cost. For fixed and flash lights there would be no need of any change in towers or refractors. The few revolving lights might be continued as now, as they are not intended to be seen at long distances, but for all the prominent lighthouses, and especially those at dangerous points where fogs and mist prevail, electricity as a lighting agent should be employed, no matter what the cost.

As showing the intensity of the electric light at long range, it may be said that at an exhibition given at Washington last week a 4,000-candle light was placed on top of the Washington Monument, 430 feet high. Its power close by was not noticeable, but at a point two miles away it threw a glare so bright that a person could read a newspaper or note the time on the face of a watch with perfect ease. There is apparently no limit to the possibilities that may be reached in the problem of lighting by electricity, and it is clear that one of them is the employment of that agent for the protection of vessels and as an did to navigation.

Platinum wire has been drawn so fine as to be absolutely invisible to the naked eye.



* * Electric lights are now in use at the Golden Eagle Hotel, Sacramento, Cal.

* * The armory of the Tower of London has been lighted by six arc lamps.

* * The Thomson-Houston people have secured contracts for city lighting in Bridgeport, Conn., and Syracuse, N. Y.

* * In Silesia, Siemens' agents have already installed 300 arc lights and 1,000 incandescents in a number of plants.

* * The annual meeting of the stockholders of the American Electric and Illuminating Company will be held in Portland, Maine, May 24th.

* * In Wimbledon, England, about a mile and a half of streets are lighted with incandescent lamps. Overhead wires are used exclusively.

* * The incandescent lamp has been very successfully used as a means of illuminating the spider lines used in telescopes, and for vernier reading.

* * In the account rendered of the cost of maintaining an electric light station in Berlin we find this item: "Food for watchdog, $22.50."

* * The Municipal Council of Munich is considering the introduction of the electric light, and a commission has been appointed to inquire into the possibility of using the fall of the Iser as a source of power.

* * The Munich Electrical Exhibition resulted in a profit of 20,000 marks, which is to be applied to the construction of a lighting station, which will be mainly devoted to experimental work.

* * The Edison Company is putting in a new and extensive plant for lighting the type setting and press floors of the Government Printing Office, Washington. This is in addition to the plant in the *Record* office, which has been in operation for some time.

* * The newly constructed buildings of "La Societe Generale Immobiliere" at Paris, are piped for gas and wired for incandescent lights, so that tenants can use either, as they wish, but the halls, staircases and offices will be lighted by electricity exclusively.

The Edison Company has 92 lamps of 16 candles each in the Holburn Viaduct, London, for which it receives the price of the gas displaced, but the business houses in the vicinity, which use 745 lights, have to pay higher figures.

* * The electric light is becoming the favorite means of lighting sugar refineries in Germany. Its absolute safety from fire recommends it for this special use, independently of the expense, which is found not to exceed that of gas.

* * The British Government refuses to pay for lighting the British Museum by electricity, and as gas is out of the question, owing to the danger to which its use would expose the invaluable collections gathered there, the museum will continue to close at sundown.

* * The Boston Post Office is wired for the Edison light, and the lamps are in place, and have been for some weeks; but there seems to be some delay about starting up, which gives rise to a good deal of comment. It is certain that the fault does not lie with the Edison Company.

* * Oban, on the west coast of Scotland, whence steamers run to Staffa and Iona, has become very popular of late years as a summer resort, and, among other improvements, wants electric lights for its streets. Incandescent lights have been decided upon, and the authorities are now in consultation with the Edison-Swan United Electric Light Company as to a system which will accomplish the desired object.

* * The Eastern District of Brooklyn is soon to have an electric light company and a plant of 250 lights in operation. The apparatus used will be furnished by the Fuller Company, and the wires will run on telephone and telegraph poles until pole rights are secured from the city authorities.

* * Gas companies are the *bête noir* of electric lighting in England as well as in America. In Leeds the gas company threw so many obstacles in the way that the electric light was not ready for use at the time of the opening of the new municipal buildings, and the local press was highly indignant.

* * The use of the gas engine is largely on the increase abroad as a means of driving dynamos, especially for isolated plants of the smaller sort. Where gas is in anyway reasonably cheap gas engines of from five to ten horse-power compare very favorably with steam in the matter of expense.

* * The hall and chapel of Emanuel College, at Cambridge, England, have been fitted with Edison lights, and it is probable that the entire college will be lighted in this way, to the entire exclusion of gas. At Peterhouse arrangements are making for the exclusive use of the electric light.

* * On the 12th inst. the Weston Company's contract with the city of Providence expired, and that of the Narragansett Electric Light Company, one of the sub-companies of the American Electric and Illuminating Company, began. The new lights—seventy-five in number—started off on time, every one burning perfectly.

* * Shanghai has the electric light, but the local company does not keep to its agreements, and the "heathen Chinee" is making it unpleasant for the officers. To be sure the company has a contract, but the simple-minded Pagans who gave it claim the right to take it away unless the work is properly done.

* * The City of Brussels means to try the experiment of using electricity to drive its street cars in good earnest. One line—that of the Rue de la Loi—is to be equipped with motors, and separate accounts are to be kept, in order to ascertain definitely the cost of running, as compared with the use of horses. The test is to last for one entire year, and then, should the result warrant it, electricity will be employed exclusively on the street railways of Brussels.

* * Professor Thompson, in a recent lecture, stated that the magnetic pole is now near Boothia Felix, more than 1,000 miles west of the geographical pole. In 1657 the magnetic pole was due north, it having been eastward before that. Then it began to move westward until 1816, when the maximum was reached. This is being steadily diminished, and in 1976 it will again point true north.

* * Brockton, Mass., has a very successful Edison incandescent plant in operation, which has just been largely increased in order to supply the demand. We learn that the introduction of the arc light has also been decided upon, and that a strong local company, in which prominent citizens have taken an active and substantial interest, has been formed to establish a 100-arc light plant, using the Jenny dynamo and lamps. Estimates have been prepared and submitted for two Armington & Sims engines, which are used exclusively by the Jenny Company, and for the necessary boilers, furnaces, and connections.

* * The Pearl Street Station of the Edison Electric Light Company is now in its nineteenth month of continuous running. According to the company's bulletin, it is at present lighting over 500 houses, wired for nearly 13,000 lamps, of which 11,272 are actually attached to the conductors, available at will. The demand for the light far exceeds the supply, and the station is now being enlarged by installing additional dynamos in the adjoining building, giving an increased capacity of about 3,000 lamps.

* * The United States Electric Lighting Company has been awarded the contract for lighting the Government buildings in St. Louis. There are to be 750 incandescent lamps, and 30 arc lights. Three Porter-Allen will furnish the motive power, two for constant use, and one as a reserve. This makes the third Government building lighted by the United States Company, those in New York and Philadelphia being the other two.

* * The Western Union Telegraph Company has contracted for 800 miles of underground cable to be made in England, to be used in New York and other cities in this country. It will probably be used for trunk lines only, connections with it being made by over-head wires as at the present time. It seems strange that the Western Union should be compelled to go to England for its cable, especially when duty and freight will add at least fifty per cent. to the price paid the manufacturer.

* * The Providence and Worcester road has had nineteen Union electric circuit signals, and nine "special" switch signals in use for twenty-three months. The end of the first division is protected by a "distance" signal 1,000 feet from the switch, and by a signal at the clearing point just above the switch. Trains coming in on the B. and P. road, if the distance signal shows danger, slow; if the home signal is against them, stop.

* * Electricity has recently been applied to protect water pipes against rupture during cold weather. A special valve is attached to the extremity of the pipe, which can be opened automatically by electricity. It is connected with a thermometer, which is so arranged as to close an electric circuit when the temperature approaches the freezing point. By the influence of the circuit, a wedge is released which allows the valve to fall into place and open the emptying faucet.

* * The net profit of the Paris Electrical Exhibition was $65,000, all of which was turned over to the Government in trust for the foundation of a central electrical laboratory, to be devoted to the investigation and promotion of electrical science. A decree has been issued announcing the institution of the laboratory, and placing it under the direction of the Minister of Posts and Telegraphs.

* *A proposition has been made to the Spanish Government to light the Royal Theater in Madrid with Gramme arc lamps, and Swan or Edison incandescents, but the Academy of Fine Arts, to whom the proposition was referred, reports against these systems and favors Edison lights. No decision has been reached, and it is not probable that anything will be done in the matter for the present.

* * The Brighton, England, electric railway, when only one-fourth of a mile long, and with one car, which had seats for only ten persons—about half the size of one of New York's much ridiculed "bob-tails"—carried 30,000 passengers in five months, and returned a handsome profit to the owners. The track has been increased to one mile in length, the car is to accommodate thirty persons, and it is believed that when all is ready a veritable bonanza will be opened for the fortunate proprietors. The plant consists of a gas engine of about eight horse-power and a Siemens dynamo and motor. Here is a hint for some one who wants to make "big money" at some one of the watering places this summer. It wouldn't cost so very much to try a mile or so of track, set up a small engine and dynamo, and use an ordinary open car in connection with a motor. Everybody would ride once for the novelty of the thing, and ten cents from each passenger would foot up handsomely. That little piece of steam road at Coney Island is called the best paying piece of railroad property in the United States in proportion to the capital invested. Run by electricity its income would be doubled.

* * A telegram from Saratoga to the Boston *Globe* says: "President Edward H. Goff, of the American Electric and Illuminating Company, of Boston, and Mr. Loren N. Downs, General Manager of the New England Telephone Company, are in town, making preliminary arrangements for establishing an electric lighting plant here. This queen of American watering places has thus far had no electric lights, except a few isolated plants, run at great expense by the big hotels, and there is a general demand on all hands for the new illuminant. The economy and excellent operation of the Thomson-Houston system makes it especially desirable here, and there is no doubt that the coming season will see a perfect blaze of light in Saratoga. The principal hotels, including those which have hitherto run their own lights, have already subscribed for the Thomson-Houston lights, and over 100 lamps have been ordered. President Goff has decided to put in a complete plant of boilers, engines, machinery and lamps for from 200 to 400 arc lights; also an incandescent plant. Mr. H. T. Downs, superintendent of the Union Telegraph and Telephone Company, is actively interested in the electric light scheme, and is very enthusiastic over the prospect. It is largely due to his exertions that the American Company has taken the initiative in the matter, and that so extensive orders for lights have been secured."

A Home-Made Electric Pen.

A description has been given by Dr. J. Garel of a simple way to make an electric pen, to be used for multiple copying of letters or drawings, to the same effect as the somewhat costly Edison pen. A tracing of the drawing to be copied is taken on thin paper, which is then laid upon a piece of common gas carbon. The larger the carbon in proportion to the paper, the less shifting will be required; but a piece of reasonably convenient size may be easily found, and it should be ground to a fair surface. The plate of carbon thus prepared is to be connected with one of the screws of a small induction coil, such as that used for an electric bell. The style for following the design is nothing more than a lead pencil, rather hard, and brought to a fine point. The other end of the lead of the pencil is connected by a wire with the other screw of the induction coil, which, in turn, is connected with a suitable battery. The wood of the pencil effectually insulates the current from the operator's hand. The arrangement being thus completed, all that is necessary is to follow the design, or to write the letter upon paper resting on the block of carbon, leaning lightly upon the pencil. As the graphite point proceeds, a continuous succession of small sparks flow between it and the carbon; and the intervening paper is accordingly perforated by an infinite number of small holes, burnt by the sparks. These holes are barely visible to the naked eye, except by holding up the paper to the light; but they can be utilized for transferring the design or writing to paper, either by dusting on a powder or by passing an inked pad over the perforations when laid on the recipient.

The Electric Diviner.

A new method of electrically locating and following veins of metal in the earth has been applied in Massachusetts. In searching for metal veins, the inventor drives two metallic stakes into the ground at the termini of the field to be tested. The stakes are connected to an electric battery and to an alarm. If the stakes have not contacted with a metallic substance, the circuit is through earth only between the posts and of too great resistance to allow the alarm to act. If, however, they have contacted with metallic matter, the circuit is closed and the alarm acts. After testing one point the stakes may be withdrawn and driven in at another point. It is claimed that by these means a large extent of territory may be rapidly and cheaply tested for metallic veins, and that if veins are found they may be easily traced.

The General Committee on Underground Communication.

THE SUBSTANCE OF THEIR REPORT.

The sub-committee on Electrical and Mechanical Devices have submitted their report to the sub-committee on Business Organization, which has transmitted it to the General Committee, which has it on file and under consideration. The sub-committee on Electrical and Mechanical Devices consists of Prof. Henry Morton, of Stevens Institute, representing the Electrical Accumulator Company; Albert B. Chandler, President of the Fuller Electrical Company; Joseph P. Davis, Vice-President of the Metropolitan Telephone Company; Frederick May, manager of the American Rapid Company; Henry W. Pope, Vice-President of the Manhattan District Telegraph Company, Garrett S. Mott, Superintendent of the Bankers and Merchants' Telegraph Company; Elihu Thomson, electrician of the Thomson-Houston Electric Company, and J. Elliott Smith, Superintendent of the City Fire Department Telegraph, with the Governor and Mayor *ex-officio* members, all of whom, with the exception of Messrs. Davis and Morton, have signed the report. The committee have examined over six hundred patents, which they have carefully classified. After stating the principal features of all of these classes, and the objections to each, the committee gave at length a description of a form of construction on which several direct wires are provided with a common return wire, both the direct and return wires being wound in long spirals on a core of any material, so that the direct and return wires always occupy the same relative position to any external wire. We quote from the report:

"A modified construction consists in laying the wires parallel and braiding or twisting them at intervals. Each of the several direct and their common return are thus arranged to be equidistant from any neighboring conductor. Each cable is, therefore, inductively independent of all adjacent cables. While inductive disturbance may be largely eliminated, there would be—when used for telephone service—some disturbance due to branch currents. This disturbance occurs only when two or more direct wires of the same cable are in use. When but one wire of a cable is in use, the presence of the branch currents in the other unused direct wires of the same cable is evidently immaterial. When the instruments on two lines are in use—in a cable of three direct wires to one return, the length of each direct wire being one mile—the disturbance is that produced by a branch current $\frac{1}{72}$ to $\frac{1}{14}$ as strong as the current on the other wire in use. The shorter the wire, the less the disturbance. This current may be that of the transmitter, *i. e.*, the speaking current, or that of the calling instrument, the latter of which would create the greater disturbance. If all three wires are in use simultaneously (which would occur very rarely) the disturbance equals that produced by about $\frac{1}{14}$ of the current on the other wires in use. In case of eavesdropping, where on one line both instruments are in use, while on each of the two remaining lines only one is in circuit, each of the two last-named circuits will get about $\frac{1}{72}$ of a speaking current. With four miles of wire, the disturbance—if two wires are in use—would be that produced by about $\frac{1}{9}$ of the current on the other wire in use. If, on long lines, instruments of greater resistance are used, which would seem desirable, the disturbance will be less than that just stated.

"It is evident that these figures are substantially correct, it being remembered that—when the instruments are in the circuit—the resistance of the return wire is proportionately very much less than that of the direct. The greater the number of instruments or lines in use, the less the number of low-resistance paths for the return current, consequently there is an increased amount of branch current to be carried by the high-resistance wires, *i. e.*, those on which the instruments are in use), and, therefore, increased disturbance.

* * * * * * *

"This system of one common return for several direct wires does not require, in its application to the telephone service, any change in existing switch-boards. The return wires of all the cables are connected together at the central office, and operate precisely as does the present ground return, except that by causing the current to return through the conduit the effect of induction is counteracted

"If two suburbs are to be connected, each having the ordinary ground return, they could not communicate with each other through the city central office without being subject to induction, unless some further provision be made. Such further provision might be a telephone repeater at the central office, or at any point in the line, or a simple induction coil placed anywhere in the line. The effect of such an instrument would be to divide the circuit into two circuits, the current in each of the latter being compelled to return the way it came.

"In the use of the switch-board, if the instruments of subscribers to be connected are on wires having the same common return, their respective wires will be connected without the use of the common return. If, however, the instruments of subscribers to be connected are on wires in different cables, *i. e.*, have not the same common return, the current must pass through the common return, as well as through the direct wire of each cable. This is made possible—without making any more connections than is now necessary—by the return wires of all the cables being always connected with each other.

"This system of one common return for several direct wires might also be used for the telegraph service with the duplex, quadruplex and automatic, as well as with the ordinary Morse instruments. The grounded wire would merely be extended parallel with the direct wires and grounded outside the area of inductive disturbance. No change in instruments or connections would be necessary. In a modification of the system just described, it is proposed to use cables for telegraph service, each of which is used as a single or grounded circuit, and to arrange these cables inductively independent of the light wires. This is accomplished as follows. The positive and negative light wires are arranged on opposite sides of the conduit. Those telegraph cables which lie in the median plane or equidistant from the positive and negative light conductors, are given a half twist at the connection boxes if not already sufficiently twisted, so that each wire of the cable is alternately on opposite sides of the exact median plane. Those cables which do not lie in the median plane are crossed at the connection boxes from one side to the other of the median plane and also given a half twist, so as to lie for equal distances in equal proximity to the positive and negative light conductors, by which arrangement the telegraph wires are rendered inductively independent of the light wires.

"The telegraph wires are not rendered inductively independent of each other by this arrangement, but this, though an objection, is not a serious one.

"For the telephone service, the anti-inductive system of one common return for several direct wires is to be used and, preferably, three direct wires are allotted to one return and the four made into a cable.

Briefly stated this plan is as follows:

1. Positive and negative light conductors arranged, respectively, on opposite sides of the conduit.

2. Telegraph wires used in single circuit, arranged in cables and rendered inductively independent of the light wires by the system of crossing before described.

3. The Fire Department telegraph, which may not in all cases desire to use a metallic circuit, and the Burglar Alarm, to have their wires placed centrally in the conduit. The Automatic Signal Telegraph Company's wires, by reason of the peculiar arrangement of the circuits, may also be centrally placed.

4. Telephone wires arranged in cables and one return provided for several direct, as before described. District Telegraph wires (Messenger Service) to be provided with common return cables, as proposed for the telephone service.

'In this plan the telegraph wires are not inductively independent of each other, but inductive effects may be to a great extent lessened by a relative change of position of the wires at intervals, so that a wire which lies for a distance in proximity to one wire or series of wires, changes its position to lie in proximity for another distance to a different wire or series of wires, and so on.

The shorter the distance any two wires lie parallel to each other, the less the inductive disturbance and, generally, the greater the number of wires which in turn lie parallel to one and the same wire, the less probability of interference from induction, for some may not be in use, or the current in some may be in an opposite direction to that of others. In the latter case the inductive effect of one would be lessened or neutralized by that of the other. This exchange of lineal positions of wires in a cable can be effected at the junction or connection boxes, and need not be done at every such box.

If the disturbance from branch currents is so little that it can be disregarded, the system of one common return for several direct wires is practically as efficient as the usual metallic circuit system, while it is considerably cheaper, and is for these reasons to be preferred.

However correct these theories may be, it would be impossible, without careful practical tests, to say positively whether such systems would meet the requirements of actual working.

As regards a conduit, the principal requirements are that it be cheap, water-tight, have sufficient capacity, permit (without disturbing the pavement) the insertion, removal and addition of wires, and allow access for repairs and testing.

* * * * * * *

Terra-cotta thoroughly coated with asphalt is a cheap material, and when protected by an outer box or covering of creosoted wood is adapted for an underground conduit of the usual form. It is unaffected by changes of temperature, there is little or no difficulty in securing and maintaining tight joints, and if properly coated with asphaltum it is indestructible.

c * * * * * *

"It has been suggested that a conduit for an inclusive system be constructed on the following plan: The central part may consist of a series of passages for the reception of cables for telegraphic and telephonic purposes. The walls of these passages may be of terra cotta properly coated with asphalt, or of wood similarly treated, or of the composition last above referred to.

"Surrounding this series of passages or central box on all sides, a layer of asphalt may be placed, in which, properly separated and held, perforated strips of paraffined wood may be imbedded to receive either naked or insulated light or power conductors, loosely inserted therein. Outside of this layer a box of asphalted terra cotta can be arranged, protected from injury by an outer box of creosoted wood. Between the two boxes a layer of tarred paper may be introduced, and the space between the wooden box and the bottom and sides of the trench may be filled with asphalt, and the top of the box covered with a layer of the same. An ideal system requires that every house or building may be connected without undue delay, cost or disturbance of the streets, with any one, or all kinds, of electrical service. This might be accomplished by lateral conduits and connection boxes placed at every alternate junction line of two buildings. The number of connection boxes and lateral conduits required will be equal to half the number of houses, and this would seem to represent the minimum number of such boxes possible without trespassing with wires on adjoining buildings or property.

* * * * * * *

"It would be found desirable in practice to make the conduit of a size sufficient to admit a person throughout its entire length, for the purpose of laying the wires and making connections and tests. Such a construction would dispense with the numerous distributing or connection boxes which are a necessity in nearly all other systems, and such a conduit may prove to be no more expensive than they. In such a conduit having its cables arranged on the sides and overhead, it would, however, seem necessary that not only the several classes of wires, but the wires of each class should be inductively independent of each other.

"In the matter of insulation of the conductors, the value and durability of an insulating material can only be determined by an actual use extending over many years. Of the numerous substances and compounds for which patents have been granted, it is impossible to say or know, without experience, that they will or will not, in use, meet the requirements.

* * * * * * *

"No system submitted or investigated by the committee seems to fulfill all the requirements so satisfactorily as a properly-constructed tunnel of sufficient size to admit the passage of workmen and access to the wires within it. Connecting with this tunnel, conduits of sufficient capacity for lateral wires could then be constructed as described. The multiplicity of subterranean structures in this city might tend to operate disadvantageously, if not to prohibit the construction of such a tunnel, unless the same were arranged to accommodate the gas, steam and other systems, as well as the electric wires. The deteriorating influences of steam and gas would, however, be apt, by destroying or impairing any system of insulation, to render the success and reliability of any system of conduits in the lower portion of the city questionable."

* * * * * * *

Then follows the report of the committee on Business Organization, which we quote in full:

"Your committee finds that no law exists which authorizes the formation of an independent company to construct, own, and lease the lines of an exclusive system, and that serious impediments to placing conduits of sufficient capacity for such inclusive system already exist in those parts of the city where the demand for very extensive accommodation is imperative and rapidly increasing.

"Your committee, therefore, recommend that the general committee apply to the Legislature of the State of New York for the creation of a commission having powers similar to those conferred by the provisions of the Rapid Transit act of June 18, 1875, and for the repeal of all acts inconsistent therewith. That commission might be placed in possession of all the correspondence and material collected by the sub-committees during the past year to facilitate and abbreviate its work. That commission might determine upon authorizing a private company to lay down an inclusive system, as provided in your instructions to this committee, or the adoption of the plan contemplated by several London parishes—that is, for the municipal authorities to lay down an inclusive system fully provided with wires for all purposes, renting them to the respective corporations and to individuals at about the cost of maintaining the present separate aerial systems. This would be a profitable property to the city, and, while contributing to lighten the burdens of municipal taxation, would extend the business of the telegraph, telephone, alarm, light, and time companies rapidly and enormously, would thus diminish the proportionate cost of performing the service, and promote the convenience of the public; the disturbance of the streets would be minimized, and the responsibility for their condition placed in the hands of those most competent to the charge. Respectfully submitted."

Some comments on these reports will be found on our editorial pages.

The Electric Light on the Dome of the Capital and Washington Monument.

A short time ago Congress granted an appropriation to be used by the Brush-Swan Electric Light Company for the purpose of testing the light at the capital city. A. A. Hayes, who is the president of the company, has carried his experiments to a successful termination.

Lights have been established on the dome of the Capitol, on the Washington Monument, and at the Smithsonian Institution. The light at the Capitol stands 285 feet from the ground, and the one at the monument is placed at an elevation of over 400 feet. The average light of the electric towers is from 100 to 150 feet. The light at the Smithsonian is about the normal height, and from it the effect of the light can be determined. The light on the monument is but temporary. It is proposed, however, when the shaft is finished to place a light on the top that will enable a person to read a newspaper at Alexandria, six miles away. The monument will then be made of some practical benefit, as well as a lasting remembrance of the father of his country. Mr. Hayes states that the lights at the Capitol and on the monument are at a higher elevation than has ever been attempted before. The three lights mentioned are within the radius of a mile, and the intervening space is illuminated as by a soft moonlight that is neither trying to the eyes nor to the nerves.

The Royal Electric Company.

This company, now in process of organization in the legislature of the Province of Quebec, Canada, is to become the owner of the American Electric and Illuminating Company's manufacturing and lighting business in Canada, securing at the same time the Thomson-Houston patents for the Dominion. The company has as directors some of the strongest financial men in Montreal, and also Mr. H. E. Irvine and Mr. M. Lee Ross, who have had an extended and valuable experience in electric lighting in New England, in connection with the business of the American Electric and Illuminating Company. The Company's capital has been fixed at $250,000, divided into 25,000 shares of $10 each, and we understand that subscriptions have come in very freely. The actual transfer to the new company cannot be made until its organization is legally complete, but in the meantime the factory is running full time on orders, and is doing a very handsome business, all of which will accrue to the benefit of the new company. Canada is an almost unbroken field for the electric light, and the Royal Company, having its own factory upon which it can draw for lamps and dynamos at cost, ought to practically control the business in the Dominion, especially with so good a light as the Thomson-Houston. As an indication that it is the intention of the managers to cover the field fully, it may be mentioned that it has a 125-light plant in operation in Montreal; one of 100 lights capacity in process of construction in Kingston, Ontario, and the negotiations are in progress for stations in nearly all the cities and considerable towns in the Dominion.

Telephonic News

*** Mr. L. G. Hough has been appointed manager of the Indianapolis telephone exchange, vice Mr. Chas. S. Smith, who takes charge of the operating department.

*** Paris, Lyons, and Bordeaux have each 14 telephone subscribers for every 10,000 inhabitants; Calais, 22; Havre, 18; Reims, 23; London, 5; Berlin, 9; Vienna, 4; and Brussels, 11.

*** The New England Telephone Company's growth is very encouraging. The increase in new subscribers last month was 186, making on April 1st 17,830 instruments in use.

*** E. S. Babcock, Jr., President of the Great Southern and Cumberland Telephone Companies, has been spending the winter in Southern California, and has only lately returned home. Mr. Babcock and Mr. Baker, Secretary and Treasurer of the two companies, were in Chicago on Monday, the 21st, in the interest of their companies.

*** A Council Bluffs editor made arrangements to hear an Italian opera by telephone, and was delighted with the evening's performance. He was not so well pleased, however, to read in a rival paper, next morning, that the people at the telephone office "set up a job," and entertained him with their own vocal music with a mouth-organ accompaniment.

*** Munich was slow to take to the telephone at first, but is now introducing it very rapidly. There are 353 subscribers and 480 sets of instruments, there being a number of private lines. Experiments between Munich and Murnau, a distance of about 40 miles, proved very successful, and an aerial cable, with 24 wires has been carried from the central office to Haidhausen, an important suburb.

*** The Frederick *Examiner* says: Samuel M. Bryan, general manager of the Chesapeake & Potomac Telephone Company, paid a two day's visit to Frederick, and was driven over our part of the Division by Supt. Miller and Manager Morgan. He expressed himself highly gratified with everything, and well pleased with the work We were sorry it was not our privilege to meet the gentleman, but hope to do so at some future time. He left for home Friday *via* the Western Maryland R. R.

*** Some experiments in long-distance telephoning have recently been made in Brussels over a circuit of 400 kilometers, all wire. The transmitter was a new one, invented by Casimir Dembinski, which, in addition to the usual carbons placed in circuit with the indpction coil, contains a carefully boxed-up piece of mechanism, which is kept a secret for the present. The conversation of two persons talking in an ordinary tone of voice at a distance of seven feet from the transmitter, was distinctly heard at the other end of the line. If that instrument ever comes into general use, a plug will be an indispensable accompaniment. Walls will indeed have ears when that transmitter gets a foothold.

*** A correspondent of the New York *Sun* makes the following suggestions: "A new word is needed to express a conversation or communication by telephone. As far as I know, no word has been proposed to meet the want. Will *The Sun* allow me to suggest to its many and critical readers a suitable word? Telepheme, from the Greek words *tele* (distant) and *phema* (that which is said), seems appropriate and euphonious. I would also suggest as suitable in meaning and etymologically correct, telemuth, from *tele* and *muthos* (discourse or conversation); telelogue, from *tele* and *logos* (speech or a word); telelesch, from *tele* and *lesche* (talk or conversation); telelaleme, from *tele* and *lalema* (talk). Can any one propose a better word than telepheme, or some one of the others named?"

*** The South-western division of the Erie Telephone Company increased its subscribers 165 in March, and has ordered 80 instruments on account of April. It is estimated that as many as 60 were added in the North-west and Cleveland divisions, making a total increase for March of 225.

*** If people who make their presence unbearable by howling into a telephone would visit a well-conducted central office now and then, and note how noiselessly the operators carry on their work, scarcely speaking above a whisper, they would learn a lesson which, if put into practice, would be a boon to those condemned to exist in company with them. They should learn that they are talking, not to the person at the other end of the line, but to the transmitter. When they send a verbal message to a friend two miles away by a boy, they don't talk twice as loud to the boy as they would if he were going only one mile. As long as the boy can hear it, a whisper will answer. Perhaps the transmitter's ear is not quite as acute as the boy's; but if it cannot hear and transmit a sentence quietly communicated, it is out of order, and needs adjusting.

*** In view of the great increase in the number of telephone subscribers in Glasgow, the opening of several new central stations has become necessary. So long as the number of these stations was not too large, the service did not offer any very serious difficulties; but as there are already seven, and as the indications are that a still further number will be required, the company has established a principal central station, through which all communication takes place. This station has no direct communication with subscribers, its function being simply to establish communication between the several sub-stations as it may be called for. At present ninety wires radiate from this principal station and connect it with the sub-stations, which are connected with a loss of time not exceeding four seconds on the average. When two subscribers, connected with the same sub-station, wish to converse, connection with the principal station is not necessary; but when subscribers connected with different sub-stations are to be connected, it must be through the principal station. The system thus far works admirably, and gives far better satisfaction than that previously in use.

Success of the Multiple Switch-Board.

A few years ago telephone superintendents and managers laughed at the idea of multiple boards ever being practically used on account of the vast amount of wires required to duplicate lines through the entire exchange system.

This has been overcome by many inventors. A great deal of ingenuity has been displayed by the Western Electric Manufacturing Company in making and perfecting the multiple board, the result of which we find working in every large city.

We notice that W. H. Eckert, general superintendent of the Metropolitan Telephone and Telegraph Company, of New York City, has just moved from their 39th Street Exchange to their new exchange on 6th Avenue and 39th Street, and have fitted the same up with the latest improved Western Electric Multiple Board. We find the capacity of this board is for 2,000 subscribers, to which 500 subscribers will be immediately cut on from the old 39th Street Exchange, thereby doing away with the older and slower system at that exchange.

The order was given for these boards to the Western Electric Company, March 1st, and were delivered in New York, March 29th.

The outside construction and switch-boards were connected up, and ready to work April 14th, which explodes the theory that it requires months to change from the old system to the new Multiple Board.

Wires entering this exchange are all brought in by 50 wire Patterson cables of which this company has eight miles in use, all giving first-class service.

We notice the following changes in the absorption of the Law Telephone Company by the Metropolitan Telephone and Telegraph Company.

Mr. W. A. Vail, brother of T. N. Vail, to whom the telephone owes its great financial success, has been appointed general superintendent of the Law Company of New York City.

The following resignations have taken place in said company: Mr. Frank Shaw, Electrical Engineer, and Mr.. Robinson, Superintendent of Construction. Mr. Childes has been retained as manager.

Suit for Infringement of the Bell Telephone.

The American Bell Telephone Company, of Massachusetts, and the Chesapeake and Potomac Telephone Company, of New York, filed a bill in equity last Tuesday, in the United States Circuit Court, against the Maryland Overland Telephone and Telegraph Company, of Baltimore City, for infringement of the patent of Alexander Graham Bell, of Salem, Mass., for speaking telephones, granted March 7, 1876, and acquired by the complainants. The bill charges that the Overland Co., of which Robert C. Hall, Geo. A. Von Lingen, John W. Middendorf, John A. Blatten, Jas. A. Gary, Hazeltine G. Vickery, Oliver C. Zell, Louis McMurray, Chas. Weber, Jr., Chas. F. Roehle and Chas. W. Hayes are directors, has made and used and furnished to others to use electric speaking telephones according to the method described and claimed in Bell's patents. The complainants ask that the defendants and their agents and employes be enjoined from making and using the said instruments, and that they may be decreed to account for and pay over to the complainants all gains and profits accruing from making and using the instruments, and damages which the complainants have sustained by the infringement of their exclusive rights. Similar suits have been brought in other States by the American Bell Company.

The Telephone in Krupp's Establishment at Essen, Germany.

After the examination by Krupp's engineers of different telephone apparatus, those of the Nederlandish Bell Telephone Company of Amsterdam, Holland, were found to be the best. This company furnishes the original American Bell Receivers, Blake Transmitters, with Williams Magneto bells.

One hundred stations exactly are now connected, and when we think that the work was commenced on January 15th, 1884, and that now 100 stations are in working order we see that much labor was done in a short time. The engineer in charge of the work was Mr. N. Heinzelman, to whose skill and energy much of the success must be attributed. The wire used is silicium-bronze wire of Lazard Weillen & Company, Angouleme, France. Some of the connected stations have a length of more than three kilometers to the central office. The central office has two Gilliland switch-boards, run by two operators.

A Telephone Time Service.

Various proposals have been made from time to time to establish a time service in cities by which the clocks in the offices of customers should be kept in unison with a standard timepiece on the premises of the time company. Electricity has usually been the agent by which such regulation was effected, though a pneumatic system was brought out several years since in Vienna, Austria, and was experimented with in Paris. In the electric systems which have been proposed the regulation is effected either by correcting at definite intervals clocks operated in the ordinary manner by springs or weights or by operating the clock electrically. In the first case the correction is done by means of various electro-magnetic devices by which the hands are moved into the proper position. In the second the hands are made to travel solely by means of electric appliances, the minute hand being moved forward each minute or half-minute.

Systems of this kind have made but little commercial progress, though they are used to a limited extent in the large cities, and it hardly seems as if the result to be obtained was worth while. A uniformity beyond that obtainable with a good watch or clock is not necessary in any place but a commercial center, and there the opportunities for getting correct time are so great, what with jewelers' and street clocks, that a special service for this purpose hardly seems warranted. However this may be it now seems as if the telephone was likely to take over to itself whatever business there is of this kind. A simple apparatus has recently been devised by which the time can be sent from an exchange to all subscribers in such a way as not to interfere with the ordinary use of the instrument. At each minute the hour and number of minutes part of the hour are clicked off at the exchange, so that the subscriber, by listening at his telephone, can readily obtain the time.

A Genuine "Bell" Telephone Company.

When Messrs. Black & Roseburgh, of Canada, were exhibiting their invention for the simultaneous transmission of telephonic and telegraphic messages over the same wire, in Washington, some time since, they were favored with the presence of no less than four members of the Bell family of telephonic fame, namely, Professor A. Melville Bell, Professor D. C. Bell (his brother), and Dr. Bell and Mr. Charles Bell, sons of the latter.

Professor A. Melville Bell is the father of Professor A. Graham Bell, and hence is the father of the inventor of the telephone. He is the author of the system of "Visible Speech," and both he and his brother have a reputation for their fine elocutionary powers.

Facilities for the experiment were afforded by the Rapid Telegraph Company. The party was divided as follows: Professor A. M. and Prosessor D. C. Bell, with Dr. Roseburgh and the telegraph agent were at one station, while Dr. Bell, Mr. Black, Mr. C. Bell, and the telegraph manager were at the other station. The tests were continued for more than an hour, and partook very much of the character of an entertainment. While the operators were pounding away on the Morse instruments, Professor A. Melville Bell stood back fully ten feet from the transmitter, and his fine, well-trained voice was easily reproduced at the other station, and afforded an elocutionary entertainment for both ends of the line.

The following is a copy of one of the messages sent, and the answer received on the Morse instrument, while Professor Bell and Mr. Black were conversing on the same wire:

To Charles Bell—How is young Miss Bell, this evening? [Signed] D. C. BELL.

To D. C. Bell—Your granddaughter, the young lady referred to was sleeping peacefully in her cot two hours ago.

[Signed] CHARLES BELL.

Mr. Charles Bell and Professor A. Graham Bell are sons-in-law of Mr. Gardner Hubbard.

The Mexican Telephone Company.

President Beaumont's statement to the shareholders on Friday last was as follows: When the present management took charge, July 1, 1883, a debt of $12,000 in June had increased to $28,000, and a further issue of 25,000 shares of stock was decided upon. This was sold at $2 per share, and from the proceeds the company paid its debts and entered upon a policy of active development. The Mexican parent company bought the Guadalajara property, which had, March 1, 1884, 155 instruments connected, with a trunk line to Ameca nearly finished, which would add 100 more. It also had 400 instruments in operation in the City of Mexico. The earnings from March 1, 1883, to March 1, 1884, were $28,000; the expenses, $11,800, leaving net, $16,200, of which $9,000 was applied to the cancellation of claims, leaving $7,200 for construction. General construction was to be closed April 1. The company receives $5 per month rental for instruments in the City of Mexico, $3 in Guadalajara,

$6@$12 on suburban lines. Its exchanges are now earning $3,000 gross and $1,300 net per month, and the outlook is every way encouraging. The report of the treasurer from July 1, 1883, to March 1, 1884, shows:

RECEIPTS.

Received from sale 25,000 shares stock at $2	$50,000 00
Supplies	2,164 60
Royalties	1,600 00
Interest	11 90
Notes payable	3,000 00
Loans	500 00
Total	$59,276 50

DISBURSEMENTS.

Notes payable (settlement old account)	$27,949 17
George L. Wiley (drafts paid)	11,070 00
Supplies shipped to Mexico	15,811 00
General expense	3,268 08
Interest	255 10
Legal expense	755 10
	$59,126 91
Balance March 1	149 79

The total number of telephones owned by the company, March 1, was 2,907; in hands of parent company, 845; leased to sub-companies, 2,907. The number of instruments in use by sub-companies was: Vera Cruz, 125; Mexican Central, 400; Chihuahua, 300; Mexican Peninsula, 200; Mexican Pacific, 254; Mexican Northern, 221; Puebla, 251; Mexican Interstate, 100; Tepic, 11; Duranga, 200. The stock in sub-companies owned by the Mexican Company was: Mexican Peninsular, 6,649 shares; Mexican Central, 7,200 shares; Mexican Northern, 3,700 shares; Mexican Interstate, 4,000 shares; Mexican Pacific, 3,000 shares; Durango, 3,600 shares; Chihuahua, 2,000 shares; Puebla, 3,000 shares; Vera Cruz (in process of organization), 1,000 shares, Tepic, 37; total, 34,086 shares. The statement of assets and liabilities is:

ASSETS.

Balance cash on hand in Mexico, March 1, 1884	$639 45
Supplies on hand at cost	29,742 28
Cash with treasurer	149 59
Due for royalties and supplies	6,978 80
Total	$37,510 12

LIABILITIES.

Notes payable	$5,000 00
Accounts payable	4,200 00
	$9,200 00
Surplus	28,310 12

The company has no indebtedness in Mexico.

Early Days of the Telegraph.

In the interesting history of a business career, the life of Ezra Cornell, one of the original promoters of the telegraph in this country, and the founder of Cornell University, written by his son, Gov. A. B. Cornell, is an account of the inception of the telegraph enterprise in this country. It seems by this that the first plan was to lay the wires under ground. Prof. Morse had got an appropriation of $30,000 to build a line from Baltimore to Washington. Mr. Cornell's connection with the enterprise began in Maine.

Mr. Cornell, who was a carpenter and a jack-at-all-trades, living at that time in Ithaca, was in Maine pushing the interests of a patent plow by the help of Mr. F. O. J. Smith, editor of the *Maine Farmer*. On one visit Mr. Cornell found Mr. Smith pondering over a new scheme. He had got the contract of laying the telegraph pipe from Baltimore to Washington, at $100 a mile, and he was trying to invent a machine that would lay it. The pipe, which was to contain this insulated wire, would be laid in a ditch two feet deep and covered; and Mr. Smith wanted a kind of scraper or machine that would dig a ditch and leave the dirt on one side convenient to be used for filling the ditch by another machine. Mr. Cornell studied this problem and became convinced that two machines were not needed. He thought the whole job could be done with one, and accordingly constructed it. It provided that the pipe, with the wires enclosed therein, was to be coiled around a drum or reel, from whence it was to pass down through a hollow standard, protected by shives, directly in the rear of a coulter or cutter, which was so arranged as to cut a furrow two-and-a-half feet deep and one-and-a-fourth inch wide. Arranged something like a plow, it was to be drawn by a powerful team, and to deposit the pipe in the bottom of the furrow, as it moved along. The furrow being so narrow would soon close itself and conceal the pipe from view. Mr. Smith insisted that the plan would not work, but Mr. Cornell persevered, constructed the machine and demonstrated its practical efficiency. This success introduced Cornell into the telegraph business, and he was employed to go to Baltimore and lay the pipe.

The process of manufacturing the pipe to contain the wire was this: The lead was first cast in ingots eighteen inches in length, containing sufficient metal for about three hundred feet of pipe, leaving a hole through the ingot of proper size for the interior of the pipe, say five-eighths of an inch. The ingots were then passed between rollers, by which they were drawn to the proper size, the four electrical wires being drawn into the pipe through a hollow mandrel during the passage of the ingots through the rollers. These were No. 16 copper wires covered with cotton yarn saturated with shellac, each wire being covered with different colored cotton yarn in order to be identified at the opposite ends of the pipe. To insure the proper insulation it was of course necessary that the pipe should be water-tight, and thus exclude dampness. Each section was subjected to a test by an air-pump.

In inspecting the process of manufacture, Mr. Cornell noticed air bubbles in the ingots, and suggested to Professor Morse that the test was insufficient, and suggested a test by a force pump, but his warning was not heeded. In October, 1843, Mr. Cornell began to lay the pipe with his machine; the machine worked well, and he was able to lay from half a mile to a mile each day. But as he went on he became convinced of the defects in the pipe, and that the wires were not properly insulated. He suggested his doubts to Mr. Vail and Mr. Avery, who had charge of the work, but they were satisfied with their own tests. But Mr. Cornell was so sure that something was wrong that he went out at midnight with a companion and made tests himself, and obtained positive evidence that the current escaped from one wire to another, and that the experiment would be a failure. He did not, however, dare to communicate his discovery to Professor Morse, but he felt sure that the work would have to be suspended. When the pipe was laid as far as the Relay House, Professor Morse one day arrived, and taking Mr. Cornell one side told him that the work must be suspended for further experiments, and asked him if he could not stop it in a manner to throw the newspapers off the scent. This Cornell instantly did by a pretended carelessness which smashed the machine, and they had to stop for repairs. Further tests convinced Morse that the insulation was defective, and no remedy could be found.

Affairs had come to a crisis. Of the appropriation $23,000 had been spent, and only $7,000 remained, while Smith claimed $4,000 on his contract, regarding the affair as a failure. This led to a quarrel between Morse and Smith, which was never healed. The remnant of the appropriation was then melting away in salaries—$2,500 to Prof. Morse; to Professor Gale and Dr. Fisher, $1,500 each; and to Mr. Vail, $1,000. Mr. Cornell then explained to Professor Morse his plan for insulating the wires, to which the latter agreed; and Cornell being appointed by the Secretary of the Treasury mechanical assistant, sat down in Washington to study. He soon discovered that the same trouble had been met in the telegraphs in Europe, and became convinced that the wires had better be put on poles. And after a time Professor Morse came to the same conclusion. The work was begun in March and completed May 1st, and so far within the $7,000 remaining of the appropriation that a balance was left to continue the salaries of Morse and Vail to the end of the year. The first news sent over the wires that astonished Congress, and convinced the country, was the reports transmitted to Washington daily of the proceedings of the Convention that nominated Polk and Dallas. But the people generally were perfectly indifferent to the invention. Government refused to purchase the invention, although it was offered at the nominal price of $100,000. Cave Johnson, Postmaster-General, reported that there was no prospect that the revenue of it would pay expenses.

Governor Cornell relates at length the great difficulty experienced in awaking any public interest in the telegraph, or in procuring money to build lines. In Boston the attempt to interest capitalists was in vain, and also in New York, where the *Tribune* and *Express* noticed the enterprise favorably, but the *Herald* treated it with contempt. The men who gave vitality to the enterprise were not capitalists, but men of quite moderate means. The first company incorporated was the Magnetic Telegraph Company to erect a line between New York, Philadelphia, Baltimore, and Washington. In 1845 Mr. Cornell built the first section between Fort Lee, opposite New York, and Philadelphia. He was paid for this work $1,000 per annum, and had such confidence in the enterprise that he devoted $500 to taking stock in the company. The first great difficulty was in crossing the North River and other streams, as no way was then discovered for insulating the wires under water. The method was to carry the wire across from high points on either side the stream. Another great trouble was in the breaking of the glass insulators, and many disastrous experiments were made to remedy this.

A sketch is given of the building of the many separate western lines, and the consolidation of these into the Western Union in 1855. From this small beginning and consolidation, this vast monopoly has grown until in 1884 the Western Union system embraces 142,459 miles of line, consisting of 422,382 miles of wire. The company maintains 12,386 telegraph offices, and employs over 20,000 persons. In 1883 its business amounted to over 41,000,000 messages, while for the last fiscal year its gross earnings were $19,454,803; expenses, $11,794,533; net profits, $7,660,350.

It would seem from this statement that the company could afford to pay fair wages to its employes and reduce the cost of messages. The biographer says that for fifteen years Mr. Cornell was the largest stockholder of the Western Union, and that he realized from his telegraph interests over $2,000,000.

Telephone Service in Providence.

In Providence the telephone exchange has not reached the dignity of numbers. Every subscriber goes by his name, and the ladies who preside at the switchboard have a remarkable faculty for remembering just where everybody's wire comes in. But they have several things to learn, nevertheless. It is always pleasant for a subscriber to get some sort of a reply from the central when he calls for any one, if only to assure him that he is understood. But that is not the way in Providence. The subscriber to the exchange is at every turn taught to feel and appreciate his insignificance. He rings up the central and gets "Hello." He meekly states that he wants Jno. Smith & Co. No notice is taken of this by the operator spoken to, but in a minute or two, provided he holds the telephone constantly to his ear, another voice asks who he wants. With increased meekness he answers, "Jno. Smith & Co." No recognition of this comes from the operator, not a word, to show he has understood it. But he must not "hang up" and wait for a ring, for it will never come. No, he must stand there holding the telephone to his ear, looking and feeling like a fool, until John Smith & Co. have been called up and have answered, unless it should happen, as it often does, that the operator has misunderstood the name and called up the wrong person, in which case the only thing to do is to "ring off" and begin the tedious round once more. Providence is a nice place, and the telephone company there is in good hands, but there is room for improvement in the service.

TELEGRAPHIC

.... The Isles of Greece are to be connected by means of cables.

.... The reduction of telegraph rates in England has been postponed until next year.

.... The Eastern Telegraph Company gave the free use of its wires to the wounded officers and soldiers in Egypt to send messages to their friends at home.

.... According to a London telegram of the 19th, parties from America are in treaty for two new Atlantic cables in addition to those of the Bennett-Mackay Company.

.... There has been a decided decrease in the number of telegrams sent over Austrian lines during the past year. Political tranquillity and financial stagnation are the causes assigned.

.... The Brazilian Submarine Company's system between Madeira and St. Vincent has been duplicated, and its line between St. Vincent and Pernambuco has been successfully repaired.

.... Mr. Mott, of the Bankers' and Merchants' Telegraph Company, was in Chicago last week, looking the ground over with a view to laying some five miles of underground cable in that city. The kind of cable to be adopted has not yet been decided upon.

.... It is not generally known, but it is said to be a fact nevertheless, that out of the nine cables that now stretch from continent to continent under the Atlantic, only three are in working order, and that of these three one only works one way. This last statement seems a singular one, and we should hardly credit it did it not come to us from excellent authority. The fact is that the life of a submarine cable is limited at best, and that from eleven to fourteen years generally uses up the best of them. The idea once prevalent that a cable once safely down was good for all time, has had to give way before inexorable facts.

.... It is probable that the telegraph will shortly be extended to three of the principal fishing stations in Orkney—namely, Holm, Burray, and St. Margaret's Hope. The Post Office department has agreed to reduce the guarantee from over £600 to £298, and the Fishery Board has agreed to guarantee this amount on the condition that those locally interested make up one-third of the deficiency they may be called upon to pay. Steps are consequently being taken to get the amount to cover the deficiency subscribed, so that the erection of the line may be proceeded with as soon as possible.

.... Siam is now blessed with the telegraph. It is a State affair, and the minister who has charge of it has a list of titles of the most gorgeous description. Siamese is the language employed for local communication, but English is also permitted. Through business may be in any foreign language, that is in anything reasonable. They don't mind French, German, Italian or Spanish, but it has been found necessary to draw the line somewhere. When a Persian merchant sends a message to his Chinese correspondent in the language of the Shah, and the pig-tailed heathen replies in the classic tongue of Confucius, it *does* bear down a little heavy on the Siamese operator, especially as errors of commission, omission and transmission are visited upon his person. So they compel correspondents to restrict themselves to reasonable languages, among which they number Russian and Polish. A Siamese operator who can't read a dozen languages or so is no good at all.

Electrical Review.

Published Weekly at 23 Park Row.

P. O. BOX 3329.

GEO. WORTHINGTON, }
WM. A. HOVEY, } - - - Editors.
THOMAS H. DELANO, - - - - Publisher.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance.

Great Britain and other foreign countries, $4.00, in advance. Postage free.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of Delano and Company, Proprietors. P. O. Box 3329, New York.

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

NEW YORK, APRIL 26, 1884.

CONTENTS.

	PAGE
Electric Batteries and Accumulators	1
Electric Propulsion	1, 2
Atmospheric Electricity	3
The Electrical Exhibition at Worcester	3
Electricity for Lighthouses	3
The Electric Pen	4
The Electric Light at the Capital	4
The Royal Electric Company	4
The General Committee on Underground Communication	5
Electrical and Scientific News	4, 5
Telephonic News	6, 7
Telegraphic	7
Success of the Multiple Switchboard	6
Suit for infringement	6
The Mexican Telephone Company	6
Early days of the Telegraph	7
Telegraph in Siam	7
An Addition to our Staff	8
The Underground Committee	8
Philadelphia Double System	8
Telephone Service in Providence	8
Electricity as a Rum Eradicator	9
The Sun's Heat Problem	9
The Electric Light in Submarine Navigation	9
Letters to the Editor	10
Electrical Patents and Market Quotations	10

An Addition to Our Staff.

Mr. William A. Hovey, of Boston, well known among journalists as former editor of the Boston *Evening Transcript*, and later as President of the Merchants' Electric Light and Power Company, of Boston, has resigned the latter position and has become a member of the editorial staff of the ELECTRICAL REVIEW. Mr. Hovey has had an extensive journalistic experience, and has been a close student of electrical science and progress for many years.

The Greek ritual forbids any lights inside the Greek church other than candles, and, when it came to lighting the Cathedral of St. Petersburg by electricity, a serious difficulty presented itself. But they found a way to whip the devil round the stump, as usual. The lamps were put outside the windows, and then an extra set of windows were put outside that. The result is that the church is lighter by night than by day, the ecclesiastical law has been complied with, and everybody is happy. Siemens lamps are used, and a rich man, named Kouraew, who probably wants to do something to expiate his sins, pays the bill.

The march of improvement is slow, but it is steady and sure, and it is always towards economy. In the earlier days of incandescent lighting the life of a lamp was comparatively short, entailing no little expense for renewal. But now lamps are so carefully made that what a year ago seemed an extraordinary duration of life is by by no means uncommon. In the Prince of Wales Theater, in London, the average life of the Maxim lamps used is over 2,000 hours.

It does not do to be too grasping. When a patent is re-issued the patentee has sometimes been unwise enough to have the re-issue cover more than the original patent, and give him rights which that did not cover. The courts have decided that this is unlawful, and that such a re issue is illegal and void, so that the patentee not only loses what he sought to obtain beyond his just deserts; but his just claim as well. *Moral*—Make the original claim as broad as the case will bear, and don't grab for "the earth" afterwards.

A great deal may be learned from the careful perusal of a daily paper sometimes; a great deal that the editor never intended should be learned. For instance, it is intensely interesting to read in the editorial columns of a "great daily" that all telegraph, telephone, and electric light wires should be put under ground, *as they are in London*," and then to turn to another page and read the letter of the regular London correspondent who, among other things, informs the reader that overhead wires are so numerous and annoying in some parts of the metropolis that the authorities have been asked to take steps to abate the nuisance. Of course one statement is as far from the truth as the other, the fact being that the London correspondent, having read his chief's constant howl against the wires, thought he would give him a lift by picturing a similar difficulty in London. But the lift was the wrong way.

It sometimes seems as though English editors must read their American exchanges with their elbows rather than with their eyes, for the amount of misinformation which they print concerning matters American is otherwise inexplicable. Here is *Engineering*, one of the most welcome of our exchanges, a recognized authority, telling its readers that the suit between the People's Telephone Company and the American Bell Company, "has just been decided by the Circuit Court of the United States in New York, in favor of the former, Bell's patent being declared void according to the American law; and Bell not the true inventor in the eyes of that law." *Engineering* has, of course, been misled, and has confounded the Overland suit with the pending Drawbaugh proceedings, but how it got so far astray as to say that Bell's patents had been declared void it is hard to see. That *Engineering* does not place the highest reliance upon what it supposes to be a judicial determination appears in its closing paragraph: "The series of instruments produced as Drawbaugh's are remarkably complete, and so perfectly anticipate the apparatus now in use, that we cannot help a suspicion as to their genuineness. The likeness is, if anything, too close, and Drawbaugh's work too obviously forestalls that of recognized inventors." And then the editor adds this remarkable paragraph: "If, however, it should turn out, *on due investigation*, that they are really genuine, Mr. Drawbaugh will deserve much honor for his great invention." Does our esteemed contemporary wish to convey the idea that the alleged decision in favor of the Drawbaugh claim, declaring the Bell patents "void," was rendered without "due investigation," and is "much honor" going to satisfy the gentleman from Pennsylvania, and his assignees, in the event of his winning the pending suit?

It is one of the stories told of Jim Fiske that while he did not believe his father would tell a lie for twelve-and-a-half cents, he feared that he could be tempted to tell eight for a dollar. It seems sometimes as though the daily press was affected in very much the same way in its statements concerning electrical affairs. It will go on for days without a single false statement, and then, all of a sudden, its columns will fairly bristle with false statements, which are so palpably manufactured out of the whole cloth that one is forced to believe that, having refused to lie at retail, and having stood the tempters off as long as possible, the editors had at last taken the dollar and given the equivalent at one sitting. In this connection it is interesting to note that, while there is not a single reputable newspaper in New York that would pretend that any one of its regular staff was necessarily competent to deal with the science of steam engineering, the majority of them will let any one of its writers say his say about the difficulties which lie in the path of the electrical engineer. Fortunately the era of politics is at hand, the dailies will have all they can do in fighting each other on political issues; and electrical affairs, like many other things which they do not understand, will have a rest.

The Underground Committee.

As will be seen by the summary which appears on another page the sub-committee on electrical and mechanical devices, and on business organization, have laid their reports before the general committee on underground communication, which now has them under consideration. The first-named committee has gone over a great deal of ground, having examined no less than 600 separate patents, and has collected much valuable information. The result is that it does not exactly recommend anything, but presents, in considerable detail, a system which it believes possesses fewer objections than any yet offered. The object is to get at an inclusive system, a system which shall put all wires in the same conduit. Theoretically it has worked out a plan, and it has had the frankness to state very fully the numerous objections which are inseparable from it. It does not cite a single instance in which this inclusive system, or anything approaching it, has been tested, and a perusal of the document leaves one in very grave doubt whether the committee itself has any faith whatever in the scheme proposed. It believes that, after all, a tunnel is the thing needed for trunk lines, but questions whether it would not be practically necessary to put all steam, water and gas pipes into this tunnel, in which event, as it freely admits, the steam and gas would in all probability ruin the insulating material, and render the system useless. It cites many instances in which telegraph, electric light and other wires are run under ground, but not one in which conductors carrying electricity for different purposes are carried side by side beneath the surface. In effect, the committee names the best system that its investigations have evolved, and then states objections to this very system which are so potent as to destroy all faith in its efficiency. And so the committee on business organization recommends that the Legislature of this State be applied to for the creation of a commission having powers similar to those conferred by the provisions of the Rapid Transit Act of June, 1875, which might be placed in possession of all the correspondence and material collected by the sub-committee during the year it has been at work.

Perhaps this is the best way out of the difficulty, but it will come to naught unless some practical experiments are to be made. A mile or two of the proposed conduit, equipped with wire for the telegraph, telephone, arc and incandescent lights, burglar alarm, gold and stock, fire alarm, and all other electrical purposes, as well as steam, gas, and water pipes, will teach the world more about the possibility of an "inclusive system" than all the pamphlets that either the present committee or a State commission can publish in the next ten years.

Philadelphia's Double System.

The disadvantages inseparable from the existence of two separate and rival telephone exchanges in the same city are well illustrated in the case of Philadelphia, where the Overland Company has set up an exchange, taking advantage of the court's unwillingness to render any decision whatever in the Bell Company's suit for an injunction, while the Drawbaugh case, based on identically the same testimony, imported in blocks into the Philadelphia suit from the Drawbaugh suit was pending in New York. It matters but little to the question in hand whether the Overland Exchange in Philadelphia is a *bona-fide* institution, established with the intention of carrying on a legitimate exchange business, or whether, as is claimed, it is set up for the purpose of making a show of business and thereby helping the sale of stock. In either case the public annoyance is the same, except that were the new exchange extended to such proportions as to give it the color of genuineness that difficulty would increase. It needs no explanation to show that under the double system everybody who wants to have the full benefit of the telephone must have two telephones, one connecting with each exchange, and that, although competition, were it genuine, might operate to reduce prices, it would hardly cut them down so far as to afford two telephones for the present price of one. Moreover, if it did, there would be a necessary doubling up of the amount of wire, and certainly this is already a sufficient burden. In a word, the telephone exchange business in any city must, almost of necessity, if the public's comfort and convenience are to be consulted, be in the nature of a monopoly, just as the occupancy of any street by a horse-railroad company must, of necessity, be a monopoly so far as that street is concerned. The new telephone exchange in Philadelphia is not, as yet, a very serious difficulty, because the number of subscribers is comparatively small and is decreasing rather than growing, but it has served to teach a lesson which it would be well to heed.

Electricity as a Rum Eradicator.

He is a rash man who undertakes to set a limit to the uses to which any of the forces of nature will yet be put in doing service to mankind, and especially is this true touching the most subtle of all forces—electricity. That it exists we know. That it is governed by certain known laws has also been proven. That there are also other laws controlling it—laws not yet formulated or understood—is more than probable; but *what* it is we certainly do not as yet know. It carries messages, lights our streets, carries power and heat, rings our alarm bells, and in a hundred ways is man's obedient servant, but it has been reserved for recent experiment to prove its efficacy as an instrument of moral reform.

It is well known that alcohol, taken into the human system, produces varied results, according to the amount absorbed. A little brings on stimulation, followed by a corresponding depression. A larger amount produces intoxication, a still larger amount stupor, and a still larger dose inevitably produces death. So long as the alcohol, which, physiologists tell us, always remains alcohol, never being broken up into its elements and assimilated by the system, remains in the body, the condition produced by it remains. The effort of nature is to throw it off by the action of the kidneys and the skin, and when it is gone the system returns to its normal state.

Now, it occurred to some one that if the system could have a little help—from outside, perhaps—the alcohol in the system might be resolved into its elements, which are perfectly harmless, and electricity was decided upon as the proper resolving agent. A man who had unfortunately imbibed more "tangle-foot" than he could carry, and whose every symptom indicated an aggravated case of intoxication, was brought into a certain lighting station one night from the street, where he had comfortably established him-

self in a doorway. One of the dynamos was slowed down until the current was so reduced as to be far below the killing point, and the man was put in circuit for an instant, the positive wire being inserted between the toes of his right foot, and the negative wire pressed into the palm of his left hand. The effect was instantaneous and startling. The patient gave a simultaneous howl and jump, and the connection was broken. But he had partially come to his senses. Then the experiment was repeated, this time through the left leg and right arm, and the result was that the man was completely sobered, and returned home to the bosom of his family.

The possibilities growing out of this startling discovery it is not easy to describe. Certain it is, that, should further experiments prove the efficacy of electricity as an eradicator of alcohol, the demand for dynamos will increase surprisingly. We may reasonably expect to see wires leading from the Brush and United States stations in this city to every police station. These will conduct currents of standard electromotive force, and at each station resistance coils will be set up to reduce this standard current to any desired strength, according to the degree of intoxication of the man in hand. Every first-class hotel will be provided with an extensive plant of this sort, which will find constant employment, especially in times of political excitement. There are clubs in New York, Boston, and other large cities, where the apparatus might be introduced to the greatest advantage, and it is not at all improbable that the electric companies will derive very considerable profit from the sale of their product to private houses, especially if it can be conveyed in underground conductors, so as not to create a scandal in the neighborhood. We understand that public tests of the eradicator are soon to be made, probably in Chicago, at the time the two great national conventions are in session. By an ingenious arrangement, which will, no doubt, be made the subject of a valuable patent here and abroad, the patients, when numerous, will be connected by insulated conductors in multiple series, and a large batch will be operated upon at once. We shall look forward with much interest to the further development of this important and interesting discovery.

The Sun's Heat Problem.

The problem of the sun's heat and how its supply is maintained has often been treated in the columns of the REVIEW because of its unusual interest. We have, too, described at length the solar engine of Captain Ericsson, by which the sun's rays may be utilized to operate machinery without the intervention of fuel or steam.

We may regard it as good as an observed fact that the sun has been radiating heat into void space for thousands or even millions of years, without any apparent diminution of the supply. One of the most difficult questions of cosmical physics—a question the difficulty of which was not seen before the discovery of the conservation of force—has been, as we said before: How is this supply of heat kept up? If we calculate at what rate the temperature of the sun would be lowered annually by the radiation from its surface, we find it to be according to the best authorities 2½° Fahrenheit per annum; supposing its specific heat to be the same as that of water and from 5° to 10° per annum if we suppose it the same as most of the substances which compose our globe. It would, therefore, have entirely cooled off in a few thousand years after its formation if it had no other source of heat than that shown by its temperature.

That the temperature could be kept up by combustion, as terrestrial fires are kept up, is out of the question, as new fuel would have to be constantly added in quantities which cannot possibly exist in the neighborhood of the sun. But an allied source of heat has been suggested, founded on the law of the mechanical equivalency of heat and force. "If a body should fall into the sun from a great height," says Prof. Newcomb, "all the force of its fall would be turned into heat, and the heat thus produced would be enormously greater than any that would arise from the combustion of the falling body.

An instance of this law is shown by the passage of shooting stars and ærolites through our atmosphere, where, though the velocity rarely amounts to forty miles a second, nearly all such bodies are consumed by the heat generated. Now, the least velocity with which a body could strike the sun (unless it had been merely thrown from the sun and had fallen back) is about 280 miles per second; and if the body fell from a great height, the velocity would be over 350 miles per second. The meteoric theory was founded on this law, and is, in substance, that the heat of the sun is kept up by the impact of meteors upon his surface. The fact that the earth in its course around the sun encounters millions of meteoroids every day, is shown by the frequency of shooting stars, and leads to the result that the solar system is, so to speak, crowded with such bodies revolving in all sorts of erratic orbits."

It is therefore to be supposed that great numbers of them fall into the sun, and the question whether the heat thus produced can be equal to that radiated by the sun, is one to be settled by calculation. It is thus found that, in order to keep up the solar heat, a mass of matter equal to our planet would have to fall into the sun every century.

This quantity of meteoric matter is so far beyond all reasonable possibility that it requires little consideration to show that the supply of solar heat cannot be thus accounted for.

Only a minute fraction of all the meteoroids or other bodies circulating through space, or revolving around the sun could strike that luminary. In order to reach the sun, they would, of course, have to drop directly to it from space, or be thrown into it through some disturbance of their orbits produced by planetary attraction. "If meteors were as thick as this," says Prof. Newcombe, "the earth would be so pelted with them that its whole surface would be made hot by the force of the impact, and all life would be destroyed." While, then, the sun may, at some past time, have received a large supply of heat in this way, it is impossible that the supply could always be kept up.

The Electric Light in Submarine Navigation.

The appearance of the storage battery in a practical form has wrought a great change in the operations of those ingenious men who devote themselves to the study of navigating the sub-current of the ocean and the rarified strata of the atmosphere. By means of the secondary battery, we can have a light that does not vitiate the atmosphere, and, above all, does not require any air.

This has encouraged Professor Charles F. Ritchell, of Bridgeport, to make some very unique experiments in submarine navigation. Professor Ritchell is quite famous in Connecticut as the inventor of numerous practical labor-saving machines, and well-known in Europe as the inventor and builder of the only flying machine ever devised that succeeded in flying. He has perfected a model of a submarine craft, with which he expects to overcome the obstacles that so long kept the civilized mariner ignorant of the surroundings of the North Pole. He seems to be quite confident that with this vessel he can navigate the sea with far less danger below the surface than above, and make much greater speed. He considers that his vessel will be indispensable to the navy, and for all expeditions in the Arctic or Antarctic Ocean.

The first machine will be of an elongated egg-shape, will be built in compartments, and will be at least two hundred feet long. It will have four huge eyes, through which the look-out can see above, ahead, behind and below. The propelling power will be a screw behind, and the lowering and lifting power a screw beneath the keel, on exactly the same principle as that of the fan-wheel used on the air-ship, whereby the vessel is made to rise or fall at the operator's desire. The vessel is made to float, but the vertical screw will draw it downward at whatever rate of speed it is running.

The Professor's plan for reaching the North Pole from Wrangel Land is to come to the surface at every opportunity in the ice openings, and, after securing enough fresh air to fill the compressed air compartments, descend again, and continue the voyage.

Twenty men, he said, could successfully operate the machine contemplated. The principle of buoyancy is the same as that of the air-ship, the equipoise being such that a slight force will govern its upward or downward movements. Should the vessel strike the earth or ice, it would bound back in the same way and for the same reason that a foot-ball bounds on the earth. It is proposed to use oil for fuel, and electricity from primary batteries for light. The vessel will be of copper.

Professor Ritchell has built a working model of his submarine craft, which he operates by means of a primary battery. This miniature is now in operation in a large tank of water at his laboratory in the Bridgeport Savings Bank Building.

The model, as said before, is worked now by electricity, but in every other particular it is rigged as will be the larger vessel. It will be readily seen how radical an improvement is Professor Ritchell's plan over the exploded theories of former inventors of submarine vessels.

You can't suit everybody. One would suppose that the musicians in an orchestra would prefer an incandescent lamp, giving no heat and no smoke or fumes, to gas, but it is not so at the Court Theater in Stuttgart. The musicians claim that they cannot regulate the light according to their eyesight as they can gas, and that the intense light hurts their eyes. One would think that a little ingenuity might devise a system of shading, but a "little ingenuity" is a very rare thing thereabouts. The only wonder is that they don't want to go back to tallow dips. A formidable royal commission, consisting of oculists and musicians, has been appointed to look into the matter. A little ground glass, or few strips of tissue paper, in the hands of a man who was not entirely a fool, would settle the difficulty and leave the "Royal Commission" no visible reason for existing.

Submarine Telegraph Communication to Light Ships.

The main difficulties attending the connection of submarine telegraph cables to light ships and other moored vessels, have been caused by the swinging of the ship, and its change of position when veering away in heavy weather The effect of the swinging is to twist the telegraph cable and the mooring chain together, and the frequent cutting away and replacing of long lengths of the telegraph cables is thus necessitated. To avoid both these evils Mr. H. M. Goodman, of Rochdale, Worpleroad, Wimbledon, has patented an apparatus which consists essentially of a hollow tube or shaft provided with suitable bearings, and with means of rotation; through this tube the mooring chain from an ordinary windlass passes. This chain, after leaving the tube, goes through the center of a rotary hawse pipe in the fore part of the ship, provided with gearing for rotating it, and thence to the anchor or mushroom mooring On the hollow chain tube is a drum which has coiled upon it a sufficient length of telegraph cable for veering away, and is provided with a friction brake band adjustable by means of screws. One end of the telegraph cable is made fast to, but electrically insulated from, the drum, whilst the other end passes through a hole in the rotary hawse pipe parallel to, but at one side of, the central hole, through which the mooring chain passes, and thence it goes to a heavy weight with a hemispherical top sunk on the sea bottom. By this arrangement the telegraph cable is paid out automatically during the veering away of the anchor chain. As the anchor chain is shortened the cable drum is rotated by gearing. By noting the direction in which the ship is swinging and suitably turning the rotary hawse pipe and chain tube, together with the cable drum, fouling of the anchor with the telegraph cable and twisting of the latter are simply and effectively prevented, the telegraph cable being untwisted by the motion of the hawse pipe at the same time as it is twisted by the motion of the vessel. To retain perfect electrical continuity between the instrument and the cable, the insulated end of the latter is connected to a disk attached to, but insulated from, the drum shaft, rubbing contact being made with the disk by a metallic strip connected with the lead passing to the operator's room. That portion of the telegraph cable between the sunk weight and ship which lies upon the sea bottom, is provided with suitable means for facilitating its passage over the ground and preventing its abrasion thereby. The details of the apparatus, a model of which has been constructed by the inventor, appear to have been thoroughly worked out in a simple and effective manner. —*Engineering.*

The gas people will want to cry quits on the danger question now that the Edison *Bulletin* has taken to publishing lists of accidents, fatal and otherwise, arising from the use of gas. These alarmists who sought to frighten the public about the danger of electricity never were honest, and the newspapers that aided them on the ground that they were merely "voicing public opinion," knew perfectly well that they had created the very public opinion, limited as it was, which they claimed to be voicing. It is an old trick, often resorted to in politics. But the public failed to respond.

"'Tain't a knowin' kind of cattle,
That is ketched with mouldy corn."

Lighting Passenger Cars by Electricity.

Mr. W. H. Massey, who is now engaged in lighting Windsor Castle by electricity, has laid before the British Association of Telegraph Engineers the results of certain experiments in lighting railway trains, which are reported as follows in *Engineering*:

"His experiments were made at the request of Mr. Forbes, of the London, Chatham, and Dover Railway on the Metropolitan District Railway, on a train running between High street, Kensington, and Putney. The work was carried out by the Electric Light Company, and the train began to run on January 3d, last. The power was supplied by a Willans engine, working at 120 lbs. pressure of steam and indicating 7 horse-power. Mr. Massey intended that the steam should be drawn from the boiler of the locomotive, but the difficulties of doing this for an experimental installation led to an independent boiler being employed. The engine, dynamo, and boiler were mounted in a parcel's van borrowed from the London, Chatham, and Dover Railway; the total weight of the gear, including one ton of water in the boiler and tanks, two hundredweights of coal, and the driver, was under 3 tons. The dynamo was a Siemens S D¹ self-regulating machine capable of driving 120 high resistance lamps, but in the present case it was only run at 530 revolutions per minute, producing current enough, 52 Swan lamps (50 volts) of nearly 20-candle power each. These lamps were distributed over the whole train, 30 being in the carriages and 20 in the machinery van. There were three lamps in each double first-class compartment, one in each second and third-class compartment, and the head and tail lamps were also lighted by electricity. The twenty lamps in the van were to bring the total number up to about fifty, which is the number required by an average train. The lamps were of 16 to 18-candle power, and were lit at first for 8½ hours each day, and afterwards for 6½ hours. The connecting wires were run in a cable laid in a wooden troughing placed along the roofs of the carriages, and they were permanently joined as the carriages were never uncoupled.

"To avoid loose connections, due to vibrations, spring contacts were employed in addition to the ordinary ones. The Willans engine and the dynamo with switches were placed in an auxiliary van near the engine. At the end of fifteen days it was found that the boiler required cleaning, but after this had been done the experiment was continued, and always with success. Only one hitch occurred, when a passenger removed a lamp bodily, and only seven lamps failed.

"The cost of the experiment was given by Mr. Massey in detail. His results showed that 211 lbs. of water evaporated at 120 lbs. pressure, fed fifty lamps of 16 to 18 candle-power with a consumption of 4¼ horse-power, which, allowing for 30 per cent. waste of power and 15 per cent. lost in friction, made a total of 7⅞ horse-power absorbed. Thirty pounds of water were evaporated per horse-power, and 2¼ cwt. of coal were consumed each 6½ hours—that is to say, each run. But the boiler was not well suited to the work and the coal was bad, and therefore he bases his calculation upon the conditions which would obtain if the steam were taken from the locomotive boiler. Assuming one pound of coal to each nine pounds of water evaporated, the consumption would be under 24 lbs. per hour, and this at 17s. or 18s. per ton would give 3s. 9d. as the cost of fuel per thousand lamp hours, the lamps averaging 18 candle-power. The cost of production might, therefore, be assumed at 3s. 9d. for coal, 3d. for water, 1s. 3d. for oil and waste, 3s. 6d. interest on plant, and 2s. 6d. renewals of lamps, or a total of about 11s. per 1,000 lamp hours, the lamps averaging 18 candle-power each. The first cost of fitting up a train with 50 lamps and suitable machinery was £170. The interest on capital expended and allowance for repairs might be taken at £40. Thus the total of 11s. per 1,000 lamp hours gave double the light of gas at a cost of 30 per cent. less than 50-candle gas at 12s. per 1,000 cubic feet. The light being good enough to see to read by, the use of reading candles was rendered unnecessary, and thus a saving could be indirectly effected by the company in the wear and tear of carriages, the use of such candles being very destructive to the furniture of a carriage."

Artificial Light.

THE DIFFERENT KINDS—ITS EFFECT ON THE HUMAN EYE.

At a meeting of the Society of Natural Sciences at Buffalo, N. Y., Dr. Lucien Howe, an authority on matters connected with the human eye, read a carefully prepared paper on "Artificial Light," and its effects on that important organ. By means of a model he showed the construction of the eye, and how light affects its outer coating and iris, expanding and contracting the form of the pupil. He said:

At the present time there are four varieties used more or less—candles, oil, gas, and electricity. The first three are in the form of a flame. When the melted tallow, sperm or wax of the candle, or oil of the lamp, is drawn up through the wick by capillary attraction, or when gas is forced out from an opening and ignited, a chemical action is at once begun. The various gases contained in the compound are decomposed, and the carbon which they all contain is set free in the form of minute particles. The accompanying heat causes these particles to glow like coals of infinitesimal fire, and the result is the flame which we see. If there is no carbon present there is no brilliancy, as when hydrogen is burned. On the contrary, if the carbon is supplied more rapidly than it can be burned, it simply passes off as soot. We say the flame smokes. The point to be gained, therefore, is to furnish just the proportion of carbon compounds that can be burned, and no more. Another remark which applies to all artificial sources of light except the electric, is the preponderance of the yellow rays and absence of the blue. It is generally considered that the red end of the spectrum is more irritating than the blue; moreover, a red light, not being as brilliant as a bluish one, requires that it be more nearly approached to the eyes, and this, of course, produces a corresponding smartness of the lids and outer covering of the globe on account of the accompanying heat. The less yellow, therefore, the flame contains, the better it is.

The intensity of candle light is so slight and the irregularity so great, that for practical purposes this illumination is worthless. The only reason why the light of the candle is of interest to us, is that this is still regarded as the standard of comparison of other lights, which are spoken of ordinarily as being of so many candle power. This depends upon a well-known law of optics which is usually stated by saying that the intensity of light varies inversely to the square of the distance.

The transition from candle to oil was a natural one, and the light of the latter was found to be the better, principally because the intensity and the regularity were greater; in other words, it was stronger and steadier. Thus a lamp of medium size is from eight to ten candle power. It has the disadvantage, on the other hand, of being rich in yellow rays, and, moreover, the amount of heat evolved is proportionately great. It is customary, at present, to use the so-called student lamp in preference to gas, not only because the oil is cheaper, but because it is erroneously said to give a softer light. On economic grounds this may be good reasoning, but otherwise the student lamp is not worthy of the confidence given it. The light is weaker, it is more yellow, and gives out more heat than gas.

Few persons appreciate what an opportunity there is for dishonesty on the part of the companies. If the amount of light furnished were one-quarter, one-third, or even one-half of the standard of purity required by the city ordinance, the difference, if noticed, would not be complained of, as it might. Under such circumstances, the company might be able to show that the amount of coal used was the same as when the gas of the standard quality was produced; furthermore, the supply might be irregular on account of some imperfection at the works, and the flickerings thus caused could easily tire and injure the eyes, or, if an undue proportion of heat were developed, they would be irritated in a similar way. In order to protect ourselves in this respect, therefore, a city ordinance should provide for the appointment of a gas inspector, who shall measure the intensity of the light furnished, and attend to other details relating to the supply. Intelligent and honest men only should fill these positions.

The electric light is evidently to be the illuminator of the future. It has an intensity much greater than any other known; it more nearly approaches white light in its spectrum, and the accompanying heat is proportionately less. The two desiderata are regularity and cheapness. The Brush light now used is, however, as yet almost worthless for domestic lighting on account of its irregularity. Some months ago I attempted to measure the intensity of a Brush light, as compared with a gas light situated on the same street. The former I found to be about forty-eight times as intense as the latter, but in one minute I counted as many as sixteen distinct variations, the limits of strength being from about thirty-six to forty-six. Evidently it would be injurious in the extreme to attempt to change the adjustment or the eye often enough to read by the light. When secondary batteries have been brought to a greater state of perfection, the Brush light may be of value for household use; but until then it can only be used as an illuminator for the streets or public halls. The form of electric light which is destined to supersede all others is that known as the incandescent electric light, such as the Maxim or Swan light. It is of great intensity, estimated at 100 candle-power; it is almost perfectly regular; its spectrum more nearly resembles that of sunlight than any other; and the accompanying heat is comparatively slight. I do not endorse the custom of hanging the lamps so low as to send an unpleasant and injurious glare into the eyes of those passing by. Colored glasses for the eyes are not of as much benefit as is usually supposed, and their continued use is often injurious.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING APRIL 15, 1884.

296,729 Electric call-bell; George P. Conant, Geneva Lake, Wis., assignor by direct and mesne assignments of one-half to Albert E. Lytle and Rober B. Smith, of Chicago, Ill.

296,774 Telegraphic cable; William R. Patterson, Chicago, Ill., assignor by mesne assignments to the Western Electric Company, same place.

296,799 Dynamo-electric machine; Elihu Thomson, New Britain, Conn., assignor to the Thomson Houston Electric Company, of Connecticut.

296,812 Electric door-bell pull; Selwyn Nivison Blake, Elmira, N. Y.

296,829 Telephone; Webster Gillett, Flushing, N. Y., assignor to the Atlantic and Pacific Telephone Company, Saco, Me.

296,849 Device for connecting the elements of secondary batteries, William Lachlan, London, England, assignor to the Light and Force Company, New York, N. Y.

296,857 Dynamo-electric machine; Adolph E. Gustav Lubke, New York, N. Y.

296,866 Electric locking mechanism for safes and vaults; Henry F. Newbury, Brooklyn, N. Y.

296,874 Electric fire-alarm apparatus; Major Dane Porter, Boston, Mass.

296,875 Electrical alarm apparatus; Major Dane Porter, Boston, Mass., and Edmund Raynsford Wilder, Portland, Me., assignor by mesne assignments to said Porter.

296,881 Insulator; John A. Seely, New York, N. Y.

297,022 Electric arc lamp; Joseph J. Skinner, Newtonville, Mass.

297,072 Apparatus for distributing electrical currents; George W. Durrow, Portland, Oregon.

297,096 Electric door-keeper; Albert C. Woehrle, New York, N. Y.

Is There a Perfect Dynamo?

Editors Electrical Review:

Will you be so kind as to inform me if there is a dynamo that will not flash? Is there any system of arc lighting that is *perfectly* steady, and that will do to light business houses? O. J. B.

There is probably no dynamo that will not flash at times, especially if not kept in perfect order. But any one of the standard makes of dynamos, when properly cared for and perfectly adjusted, will flash so little as to do no harm. There is no system of arc lighting that is *perfectly* steady, just as there is no gas light that is absolutely steady; but all the leading systems are in use in business houses, and give good satisfaction. Of course, each claims to be the best.

Texts Books on the Galvanometer and Telephone.

Editors Electrical Review:

What are the best books for me to read concerning the telephone and its uses, and the galvanometer and its uses?

A FRIEND IN NEED.

Lockwood's "Electricity, Magnetism, and the Electric Telegraph," published by Van Nostrand, New York, and "Electrical Measurement," by the same author, published by J. H. Bunnell & Co., New York, will give you the information you seek. Any bookseller can get them for you.

E. T. Barnum, Wire and Iron Works, Detroit, Mich., has just completed a $100,000 plant in Detroit, and will build a new factory in Windsor, Ont., this spring, and put in several new and improved steam looms for wire lathe cloth and wire malt kiln floors by power.

Any of our readers having copies of the old REVIEW of the TELEGRAPH AND TELEPHONE, dated March 15th, 1882 (No. 3), not specially needed by them, will confer a great favor upon us by sending them to this office, for which we will remit twenty-five cents per copy. DELANO & COMPANY,
23 Park Row, New York.
Box 3,329.

BUSINESS NOTICES.

A. C. NORTHROP, Waterbury, Conn. Iron and Brass Machine Screws, Zinc in Sheets and Plate for Electrical Purposes, Parts for Telephone and Telegraph Instruments, Manufactured from Iron, Brass, Steel or Zinc.

A. G. DAY, Kerite Insulated Telegraph and Telephone Wire and Cables, Anti-induction Kerite Telephone Cables, CLARKE B. HOTCHKISS, New York. Send for circular and prices.

ALFRED F. MOORE, Philadelphia, Pa. Telegraph, Telephone, Electric Light, Office, Line and Annunciator Wire.

AMERICAN BELL TELEPHONE Co., Boston, Mass. Electric Speaking Telephones for Exchange Systems, Private Lines, and Speaking-tube Lines.

AMERICAN ELECTRICAL WORKS, Providence, R. I. Patent Finished Insulated Electric Wires, Telephone and Electric Cordage. Electric Light Wire, Magnet Wire, Patent Rubber covered Wire. Aerial and Underground Cables, &c., &c. Send for prices.

AMERICAN INSULATOR COMPANY, New York. Insulators of all sizes.

AMERICAN SPIRAL TELEPHONE WIRE Co., Boston, Mass. Spiral Telephone Wire for long and short distance Telephoning. Write for information.

ARMINGTON & SIMS, Providence, R. I. Engines for Electric Lighting and general use.

AUSTIN GALLAGHER, New York. Keith Electric Light System complete for Arc Lighting. Stock for sale.

BAXTER ELECTRIC LIGHT COMPANY, New York. The Baxter Lamp.

B. W. PAYNE & SONS, Corning, N. Y. The Payne Single and Double Valve Automatic Engine. Send for catalogue.

BERGMAN & Co., New York. The Bergman and Haid Battery for Telephone and Telegraph purposes. Send for circular.

BOULTON CARBON Co., Cleveland, Ohio. Carbons for Electric Light purposes. Send for quotations.

BROWNLEE & Co., Detroit, Mich. Telegraph and Telephone Poles.

BRUSH ELECTRIC Co., Cleveland, Ohio. Arc Lights and Brush Storage Batteries.

BUFFALO ELECTRIC WORKS, Buffalo, N. Y. Carbon Points and Plates.

BUTLER HARD RUBBER COMPANY, New York. Rubber Insulators and Electrical Supplies of every description.

BUTLER SAFES, New York. Fire and Burglar-Proof.

CHARLES WILLIAMS, JR., Boston, Mass. Call Bells, Electric Bells, District Bells, Switch Boards, Annunciators, &c., &c. Write for quotations.

CHICAGO INSULATING Co., Chicago, Ill. The Fiske-Mott High-resistance Insulator. Send for circular.

CHROME STEEL WORKS, Brooklyn, N. Y. Steel for Magnets a specialty; Chrome Cast Steel.

COE BRASS Co., Torrington, Conn. Brass, Copper and German Silver in every variety of Sheets, Rolls, Plates, Wire, Rods and Blanks or Shells. Pure Lake Superior Copper Wire and Battery Zincs. Write for price list.

CONNOLLY BROTHERS, New York, Patent Attorneys and Solicitors.

CORNELL UNIVERSITY, Ithaca, N. Y. Electrical Engineering.

D. VAN NOSTRAND, New York. Scientific Books. Send for circular.

ELECTRIC STORAGE AND LIGHT Co., Boston, Mass Own patents for Faure's Storage Batteries for territory of Rhode Island, Connecticut and Massachusetts.

ELGIN STEEL TOWER COMPANY, Elgin, Ill. Electric Light Towers.

HARVEY, STAFFORD & Co., Acton, Ont., Canada Telegraph and Telephone Poles.

H. M. RAYNOR, New York. Platinum for all purposes.

HOLMES, BOOTH & HAYDENS, New York. Fireproof Electric Light Wire, Patent "KK" Insulated Copper and Iron Wire for Telephone and Telegraph use. Send for catalogue and prices.

I. W. COLBURN & Co., Fitchburg, Mass. Dynamo Electric Machines.

IVISON, BLAKEMAN & TAYLOR, New York. Ink of all kinds and colors. Circulars sent on application.

JARVIS ENGINEERING COMPANY, Boston, Mass. Boilers set with the Jarvis Patent Furnace.

JOHN H. MUEGGE, New York. Platinum, Chemical Apparatus, Crucibles, etc.

LECLANCHE BATTERY COMPANY, New York. The Great Telephone Battery. Write for description and prices.

J. H. BUNNELL & Co., New York. The Morse Learner's Instrument, Telegraph Instruments of all kinds, Telephone and Telegraph Supplies. Illustrated Works on Electrical Measurement, and the Galvanometer and its uses. Send for catalogue.

LAW TELEGRAPH Co., New York. The Law Battery for Telephone and Telegraph purposes.

LOCKWOOD & FOSTER, New York. Learners' Telegraph Instrument.

MUTUAL DISTRICT MESSENGER Co., Boston, Mass. Addressing and Distributing Circulars &c., &c. D. J. Hern, General Manager.

NATIONAL ELECTRIC COMPANY, Washington, D. C. Electrical supplies and apparatus.

NEW ENGLAND BUTT COMPANY, Providence, R. I. Braiding Machinery for covering Telegraph, Telephone and Electric Light Wire, Single and Double Winders and Braiders of every description; also Fine Castings. Send for catalogue.

O. W. MADDAUS, New York. Designer and Engraver.

PAINE & LADD, Washington, D. C. Attorneys in Patent Causes, and Solicitors of Patents.

PALMER WIRE Co., Palmer, Mass., and New York. Galvanized Telephone and Telegraph Wire Iron and Steel Wire of best quality, Material, finish and conductivity. Write for quotations.

PARTRICK & CARTER, Philadelphia, Pa. Electric Annunciators, Learners' Instruments, Batteries and Telegraph and Telephone Supplies. Write for circulars.

PHOSPHOR BRONZE SMELTING Co., Philadelphia, Pa. Telephone Wire, insulated and bare.

RHODE ISLAND TELEPHONE & ELECTRIC Co., Providence, R. I. Manufacturers of the Providence Telephone Switch Boards, Breckenridge Jacks, Wright Cable Clips, Howard Safety Appliances, &c.

ROYCE & MAREAN, Washington, D. C. Dealers in Electrical apparatus, Telegraph and Telephone supplies.

SCHLEICHER, SCHUMM & Co., Philadelphia, Pa. Manufacturers of the Otto Gas Engine. Write for catalogue.

THE FREEMAN & ROE ELECTRICAL SUPPLY COMPANY, New York. Electric Light Machines, Motors, Dynamos, Telegraph and Telephone Apparatus.

STANDARD ELECTRICAL WORKS, Cincinnati, Ohio. Manufacturers of Telegraph and Telephone Instruments, Magneto Bells, Switch Boards and Telephone Exchange Apparatus, Annunciators, Wire, Batteries, Insulators, Electric Light Wire and Supplies. Send for circular and prices.

SWAN INCANDESCENT ELECTRIC LIGHT CO., New York. Incandescent Lights, and Complete Apparatus. Send for illustrated catalogue.

THE ANSONIA BRASS AND COPPER CO., New York. Pure Electric Copper Wire for Magnets, Telephone Lines, and Electric Light purposes, Office Wire, Zinc Rods and Battery Copper.

THE BISHOP GUTTA PERCHA WORKS, New York, Gutta Percha Insulated Submarine Telegraph Cables Subterranean Telegraph Cables, Aerial Telegraph Cables, Lead or Hempen covered Torpedo Cables, Lead-covered Cables, Telephone Cables of all kinds —G. P. Office Wire, and Marks' Compound Insulated Wire, &c., &c. Send for catalogue.

THE BUTLER HARD RUBBER COMPANY, New York. Electrical supplies, Rubber Hook Insulators, Hardwood Tubes, Plug Handles, Lamp Switch Handles, Battery Syringes, etc.

T. H. ALEXANDER, Washington, D. C., Solicitor and Counselor in Patent cases.

THOMSON-HOUSTON ELECTRIC CO., Boston, Mass. Automatic Self-regulating System of Arc Lighting.

THE ELECTRICAL SUPPLY CO., New York. Electric Light, Telephone and Telegraph Supplies. Send for price list and catalogue.

TRENTON IRON CO., Trenton, New Jersey. Galvanized Iron and Steel Wire of all kinds for Telephone and Telegraph purposes. Write for prices.

TROPICAL AMERICAN TELEPHONE COMPANY, Boston, Mass. Telephones and Telephonic apparatus, for Mexico, Central America, West India, and South America.

UNITED STATES ELECTRIC LIGHT CO., New York. Arc and Incandescent Lights, complete and reliable systems, &c. Write for information.

UNION ELECTRIC MANUFACTURING CO., New York. Manufacturers of all kinds of Telegraph, Telephone and Electric Light Apparatus. Send specifications.

VIADUCT MANUFACTURING COMPANY, Baltimore, Md. Electrical Goods of every description. Electric Light and American District supplies. Send for price-list.

VICTOR, BISHOP & CO., New York. Platinum for all Manufacturing, Chemical and Electrical purposes. Send for prices.

WESTERN ELECTRIC CO., New York, Boston, and Chicago. Telegraph and Telephone Apparatus and Supplies of every description. Send for catalogue.

WM. A. HARRIS, Providence, R. I. The Harris-Corliss Steam Engines and Light and Heavy Castings.

WATTS, CAMPBELL & CO., Newark N. J. Improved Corliss Steam Engines. Send for catalogue.

W. R. POPE & CO., Baltimore, Md. Telegraph, Telephone, and Electric Light supplies. The best of everything, and at lowest prices.

Average Market Quotations of Battery Supplies for the Week Ending April 24th, 1884.

Leclanche Disque Cell, complete	$1.25
" Prism " "	$1.67
" Prisms, per pair	$1.00
" Carbon Mounted	30c.
" Jar Cover	12c
" Sal Ammoniac, in bag	8c
" Porous Cell	$1.10
" Glass Jar	18c.
" Amalgamated Zinc	10c.
" Rubber Bands, per pair	6c.
Chlorine Battery, per cell	$1.25
Law Battery, per cell	$1.25
" Jar and its Rubber Ring	25c
" Cover, with small Carbon sealed in	35c.
" Large Carbons, each	20c.
" Carbon Connector	12c.
" Zinc Connector	8c.
" Rubber Bolt	12c.
" Zinc and its Rubber Ring	12c.
Bergman & Haid, per cell	$1.20
Crow foot, 6x8, per cell	75c.
Callaud Zincs	30c.
" Coppers	15c.
" Jars	25c.
Sal Ammoniac, per lb	15c.
Blue vitriol, per lb	10c.
" " bbl., lots, per lb	5½c
Sulphate of zinc	10c.
Battery syringe	$1.90c.
Battery brush	20c
Hydrometer	50c.

Send to our advertisers for price lists.

Electric Manufacturers and Miscellaneous

STOCK EXCHANGE,

9 NASSAU ST., N. Y.

Daily Sales of Telephone, Electric Light and Telegraph Stocks, also Stock of Manufacturing, Railroad, Mining and Gas Companies and miscellaneous securities of every description.

Listing securities of a general character solicited.

For rates of commission, terms for listing daily quotations and other information, address,

ALBERT H. JOCELYN, Sec.,

DUNCAN BUILDING,

11 Pine Street, NEW YORK.

Wanted.

Exchange managers or other responsible parties in every city or town to act as agents for Gilliland's latest invention to be used in connection with the telephone. Sells at sight. Sample sent prepaid on receipt of one dollar. Address

GILLILAND MFG. CO.,
Indianapolis, Ind.

ELECTRICAL AND MECHANICAL ENGINEER, very experienced in designing dynamos and lamps, &c., &c., wants position as electrician, with already established or now forming company. Address "Electrician," P. O. box 88, Greenpoint. L. I.

Notice.

The new (1884) edition, "Berly's Universal Electrical Directory," now ready for delivery, price $3, has been thoroughly revised, greatly enlarged, and many new features added to enhance its value. Send for descriptive circular and table of contents. Cumming & Brinkerhoff, 219 East Eighteenth Street, New York City.

WANTED.—An experienced telephone man that can take position of managing an exchange, and will work himself in construction. Address Foreign, care of ELECTRICAL REVIEW.

The Ansonia Brass & Copper Company of New York, is now manufacturing what it calls "acme bronze" wire, especially for telegraph and telephone purposes, which is highly spoken of. Lake Superior copper is used in its construction.

Neatly-bound volumes (half-yearly) of the ELECTRICAL REVIEW will be sent, postage prepaid, on receipt of $3; also the latest improved self-binders for the ELECTRICAL REVIEW, or any other electrical or scientific journal published in this country, for $1. Delano & Company, publishers, 23 Park Row, New York, N. Y.

Telephone Stocks

BOUGHT AND SOLD BY

J. O. SHIRAS, No. 11 West Third St., Cincinnati, O.

NOW READY.

Electrical Measurement AND The Galvanometer and Its Uses.

BY T. D. LOCKWOOD.

144 pages, handsomely bound, large clear type, and fully illustrated with diagrams of connections, engravings of apparatus, etc. Price, $1.50. Sent by mail, Postpaid, to any Address upon receipt of price.

Every Telegraph Office Manager, or Telegraph Operator, every Telephone Central or District Telegraph Manager, every Student of Electrical Science, every person having charge of Electric Light Plant, or other Electrical Arrangements and Apparatus, and every person who takes an interest in Electrical Matters of any kind, should read

T. D. LOCKWOOD'S

"Electrical Measurement and the Galvanometer."

It is the only book which EXPLAINS in PLAIN ENGLISH and without algebraic formulae all about Electric Measurement and the Use of Galvanometers, besides giving fully detailed and illustrated description of

GALVANOMETERS & RHEOSTATS,

with all diagrams of connections required in using them, and the plain and simple reason why for everything.

In this remarkable book the whole subject of Electrical Measurement is made so clear and plain that ANY ONE can easily understand every explanation, and can practically make electrical measurements without difficulty, and especially without "doing" sums in algebra.

PUBLISHED BY

J. H. BUNNELL & CO.

812 Liberty Street, New York,

TO WHOM ALL ORDERS SHOULD BE SENT.

CONNOLLY BROS.,
Patent Attorneys
AND SOLICITORS,

MORSE BUILDING,
Cor. Nassau & Beekman Streets,
NEW YORK.

PHILADELPHIA, PA.,
Mutual Life Insurance Building,
10th AND CHESTNUT STREETS.

WASHINGTON, D. C.
914 F STREET.

ELECTRICAL CASES A SPECIALTY.

THE BUTLER HARD RUBBER CO.,

33 MERCER STREET, NEW YORK,
Manufacturers of

HARD RUBBER,

Sheets, Rods, Tubing, etc.,

ELECTRICAL SUPPLIES

Rubber Hook Insulators,
Window Tubes with Heads,
Key Knobs, Switch Handles,
Plug Handles, Lamp Switch Handles,
Battery Syringes, etc., etc.

Specialties of any PRACTICABLE CHARACTER made to order.

T. H. ALEXANDER,

Solicitor and Counsellor in Patent Cases
607 7th St., Washington, D. C.,
OPPOSITE PATENT OFFICE.
Twenty-three Years' Practice.

Expert examinations and opinions, relating to Infringements, Validity and Scope of Patents, Caveats, Designs, Trade-Marks, European and Canadian Patents. For information on Patent matters, send stamp for my "HINTS TO INVENTORS."

PAINE & LADD,

ALBERT E. PAINE, Late Commissioner of Patents. STORY B. LADD.

Attorneys in Patent Causes
And Solicitors of Patents,
WASHINGTON, D.C.

MANUAL OF TELEGRAPHY.

Send your address on a postal card and receive free by return mail the most complete learners' instruction book published. Gives in clear concise language instructions so comprehensive that to learn the art of telegraphy from its pages will be found a comparatively easy task. Contains progressive series of practice lessons; is illustrated with cuts and diagrams and replete with information concerning private lines. Gives directions for setting up and using instruments and tells how to keep telegraph lines in working order. Contains battery directions, estimates of cost of short lines, and information in regard to commercial telegraphy. Unquestionably the best learner's book ever compiled. Do not fail to send for it.

WESTERN ELECTRIC CO.,
Chicago. Boston. New York.

CORNELL UNIVERSITY.

COURSES IN
Electrical Engineering,
Mechanical Engineering,
Civil Engineering,
and Architecture.

Entrance Examinations Begin at 9 A.M., June 16 and Sept. 16, 1884.

For the UNIVERSITY REGISTER, containing full statements regarding requirements for admission, courses of study, degrees, honors, expenses, free scholarships, etc., and for special information, apply to THE TREASURER OF CORNELL UNIVERSITY, Ithaca, N. Y.

JUST OUT.

Electricity, Magnetism
AND
Electric Telegraphy.

A Practical Guide for Students, Operators and Inspectors,
BY
THOMAS D. LOCKWOOD,

PRICE, $2.50
379 PAGES, WITH 130 ILLUSTRATIONS.
D. VAN NOSTRAND, Publisher,
23 Murray and 27 Warren Sts., N. Y.
Complete Catalogue of Electrical Works will be sent to any address on application.

THE BRUSH ELECTRIC CO., CLEVELAND, OHIO.

The Sole Manufacturers under all the Patents of CHAS. F. BRUSH for
ELECTRIC LIGHTING, STORAGE BATTERIES, ETC.
We furnish the only complete and PERFECT SYSTEM of electric lighting.
THE BEST DYNAMO MACHINES.
THE BEST ARC LAMPS.
The Only Practical Storage Batteries.
The Purest and Best Carbons, &c.
Our prices are the lowest, our factory the largest and our business the most extensive in the world to-day.
Price, Single Lamps $50.00, Double Lamps $60.00.
SEND FOR DETAILS.
THE BRUSH ELECTRIC CO.,
No. 104 EUCLID AVE., CLEVELAND, OHIO.

Electric Light Machines.
STANDARD SIZES.

No. of Mch.	No. of Lights 2,000 c. p.	No. of Lights 1,200 c. p.	Horse Power Required	Price.
2	1		1¼	$300.00
2		2	1½	300.00
3	2		3	415.00
3		3	3	415.00
4	4		4	565.00
4		6	4	565.00
5	10		8	900.00
5		15	8	900.00
6	20		14	1,500.00
6		30	14	1,500.00
7	30		22	2,000.00
7		45	22	2,000.00
8	65		45	3,600.00

INCANDESCENT LIGHTS

SWAN INCANDESCENT ELECTRIC LIGHT CO.
OWNERS OF THE
SWAN PATENTS FOR THE UNITED STATES,

ARE PREPARED TO GRANT LICENSES TO COMPANIES TO SELL AND USE THE SWAN INCANDESCENT LAMP, INCLUDING OUR PATENTED HOLDERS, SWITCHES, CUT-OFFS, ETC. WE GUARANTEE OUR LAMP AND TO DEFEND THE VALIDITY OF OUR PATENTS. FOR TERMS OR INFORMATION, APPLY TO

THE SWAN INCANDESCENT ELECTRIC LIGHT CO.,
853 Broadway, Cor. 14th Street, New York

BOULTON CARBONS

These carbons are made of the
BEST MATERIALS,
and with the latest improved machinery, of **any required degree of hardness,** and can be used in all makes of Electric Lamps.
The regular sizes, 12 inches long, run from ¼ inch to 1 inch in diameter, varying by sixteenths.
Special LENGHTS and SIZES to Order.
A large and complete stock always on hand.
The want of a high order of battery plate has long been felt. Those wishing such would do well to use the
BOULTON PLATES.
Special attention is given to the manufacture of all sizes to order.
Price Lists and full information furnished on application.

BOULTON CARBON WORKS,
PAYNE AVENUE,
CLEVELAND, O.

SPENCERIAN INK

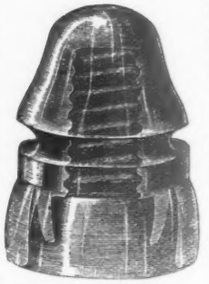
Extra Black, Blue Black, and Copying, all of superior quality, claiming **Special excellence** in the essentials of **Fluidity, Color** and **Durability.** Circulars free.
Ivison, Blakeman, Taylor & Co., N. Y.

ELECTRIC LIGHT TOWERS

ELGIN, ILL.,
THE ELGIN STEEL TOWER CO.,
GEORGE S. BOWEN, General Manager. Elgin, Ill.

FOR SALE
10 GILLILAND SWITCH BOARDS,
ALL IN FIRST-CLASS CONDITION.
Great Southern Telegraph & Telephone Co.,
NASHVILLE, TENN.

THE AMERICAN INSULATOR CO. OF NEW YORK


"DOUBLE PETTICOAT."

calls attention to their new full screw (TRADE MARK.) "DOUBLE PETTICOAT" patent glass insulators, which for high insulation, beauty, strength, durability, and perfect screw excel any insulator ever invented. The large Telegraph Companies are now using our "Double Petticoat" Insulator exclusively.

To the American Insulator Company of New York.

GENTLEMEN, New York, April 20, 1884
I have made several comparative tests of your "DOUBLE PETTICOAT" Glass Insulator and the ordinary glass insulator heretofore universally used by the different Telegraph and Telephone Companies, and as a result find the SUPERIORITY of your Double Petticoat Insulators to range from 30 TO 83 PER CENT; the highest per centage of superiority occurring in the worst weather, just the time it is most needed. Yours truly,
G. A. HAMILTON, ELECTRICIAN, WESTERN UNION TELEGRAPH CO.,

We have two sizes of the larger "Double Petticoat" Glass, viz. 22 ounces and 18 ounces.
Price, for 22 ounce "Double Petticoat" Insulators, 6½ cents net, delivered on the dock at New York.
Price, for 18 ounce Glass, 5½ cents.
Price, for Standard, 4 cents net same terms as above.
Liberal discount to the trade.

"STANDARD."

THE AMERICAN INSULATOR CO. Room 155 Temple Court, New York.
D. J. HERN, General Manager. H. C. ANDREWS, Treasurer.

THE EXCELSIOR TELEPHONE WIRE.

RECOMMENDED FOR
High Conductivity, non-liability to corrosion, great tensile strength, and power of overcoming stretch, or sagging, and lightness of weight.

Table Showing Tests of the Excelsior Telephone Wire.

B. & S. Gauge.	Resistance per Mile.	Breaking Strain.	Twists in 6 inches.	Price per Mile.
No. 12....	8.3 ohms.	355 lbs.	60	$27.00
13....	10.5 "	235 "	69	23.00
14....	13. "	205 "	78	18.50
15....	17.2 "	165 "	86	14.50
16....	23.8 "	120 "	94	10.00

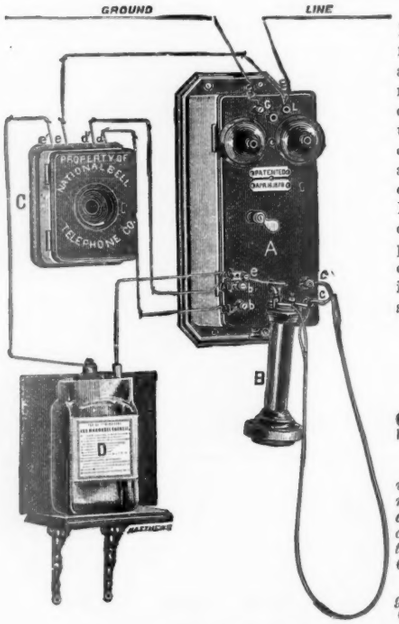
Put up in continuous lengths of one-half or one mile, as desired.

Samples and Further Information On Application.

THE ELECTRICAL SUPPLY CO., SOLE AGENTS,
17 DEY STREET, NEW YORK.

THE American Bell Telephone Co.

WM. H. FORBES, *President.* THEO. N. VAIL, *Gen'l Manager.* WM. R. DRIVER, *Treasurer.*



This Company owns the Original Patents of Alexander Graham Bell for the Electric Speaking Telephone, and other patents, covering improvements upon the same, and controls, except for certain limited territory, under an arrangement with the Western Union Telegraph Co., the Gold and Stock Telegraph Co., the American Speaking Telephone Co., and the Harmonic Telegraph Co., the Patents owned by those Companies, and is prepared to furnish telephones to the citizens of the United States through its local Licensees, on the following systems:

EXCHANGE,
PRIVATE LINE, &
SPEAKING TUBE LINES

Those desiring instruments on Private or Speaking Tube Lines, or connections on Exchanges, will please apply to the nearest Licensed Exchange, when their case will be brought to the attention of the proper local Company.

Any further information will be gladly furnished on application to the Company at its office,

No. 95 MILK STREET, BOSTON, MASS.

All persons using telephones not licensed by this Company, are hereby respectfully notified, that they are liable to prosecution, and for damages for infringement, and will be prosecuted according to the full extent of the law.

THE THOMSON-HOUSTON ELECTRIC CO.

Principal Office, 131 Devonshire St., Boston, Mass.,
FURNISHES THE
ONLY PERFECT AUTOMATIC, SELF-REGULATING SYSTEM OF ELECTRIC ARC-LIGHTING IN THE WORLD.

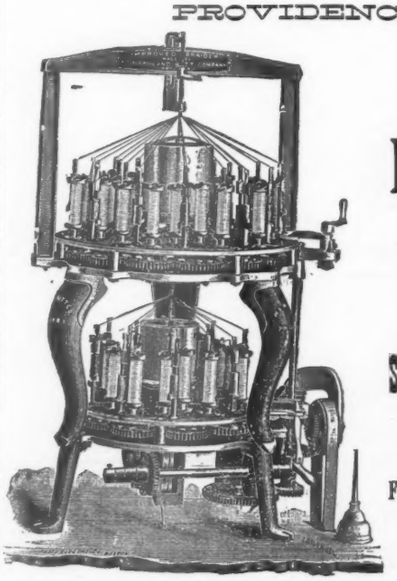
In all desirable qualities of ELECTRIC ARC LIGHTS the THOMSON-HOUSTON SYSTEM has no equal. The Lights are *superior in color and steadiness,* and the entire apparatus is more *economical, efficient* and *safe,* more *easily managed,* and *less liable to derangement* than any other.

THE THOMSON-HOUSTON ELECTRIC CO. was awarded the FIRST PRIZE for the *best system* of arc lighting, and the *best Arc Lamp,* at the Cincinnati Industrial Exposition of 1883.

The Thomson-Houston System has been awarded *superiority in all the competitive tests* to which it has been subjected. NEW ILLUSTRATED PAMPHLET will be sent on application.

NEW ENGLAND BUTT CO.

PROVIDENCE, R. I.



MANUFACTURERS OF

BRAIDING MACHINERY

FOR COVERING
Telegraph, Telephone and Electric Light Wire
ALSO
SINGLE AND DOUBLE WINDERS
AND
Braiders of every description,
For Silk, Worsted and Cotton Braid.

FINE CASTINGS
A SPECIALTY.

The Coe Brass Mfg. Co.

MANUFACTURERS OF

BRASS,

Copper & German Silver,

IN EVERY VARIETY OF

SHEETS, ROLLS, PLATES, WIRE, RODS & BLANKS OR SHELLS,

Pure Lake Superior Copper Wire

A SPECIALTY,

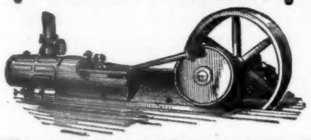
BATTERY ZINCS.

TORRINGTON, Litchfield Co.,

CONN., U. S. A.

THE PAYNE

Single and Double Valve Automatic Engine.



Will guarantee 20 per cent. better regulation with our *single slide valve automatic engine* than can be attained by any other engine in the market. For sale by E. P. Hampon & Co., 36 Cortlandt St., N.Y., Hill, Clark & Co., Boston, Mass. Write for Circular No. 36. B.W. Payne & Sons. Box 1450, Corning, N.Y.

MAGNET STEEL

AND ALL KINDS OF

CHROME CAST STEEL.

STEEL for MAGNETS

A SPECIALTY,

And warranted superior to all other brands.

CHROME STEEL WORKS,

Brooklyn, E. D., N. Y.

S. H. KOHN, *Proprietor.* C. P. HAUCHIAN, *Superintendent.*

CHARLES WILLIAMS, JR.

[Established 1856.]

Nos. 109-115 COURT ST., BOSTON, MASS.

AUTHORIZED MANUFACTURER OF

THE AMERICAN

BELL TELEPHONE CO.

Magneto, Crank and Push Button

CALL BELLS,

ELECTRIC BELLS,

DISTRICT BELLS

AND

Switches for Exchanges, Annunciators, &c.

Telegraph and Electrical Instruments, Batteries, Wire, Insulators, and Telephone Supplies of every description.

JARVIS ENGINEERING CO.,

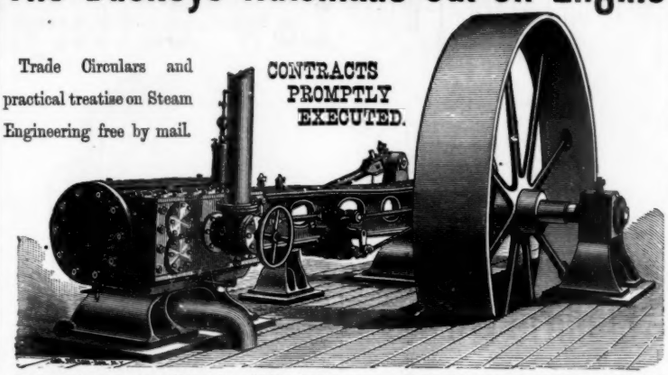
BOSTON.

Boilers Set with the Jarvis Patent Furnace to burn Pea Coal, Screenings or Slack without a blower. Send for Circulars.

The Buckeye Automatic Cut-Off Engine

Trade Circulars and practical treatise on Steam Engineering free by mail.

CONTRACTS PROMPTLY EXECUTED.



These engines are carefully constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable economy in consumption of steam, and superior regulation guaranteed.

Address, BUCKEYE ENGINE CO., Salem, Ohio; or GEO. A. BARNARD, Eastern Sales Agent, Astor House, N. Y. D. L. DAVIS, Sales Agent, 23 S. Canal Street, Chicago, Ill.

WATTS, CAMPBELL & CO., NEWARK, N. J.

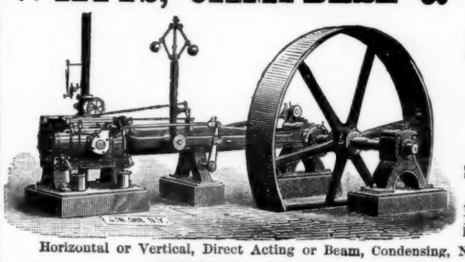
MANUFACTURERS OF

Improved Corliss

STEAM ENGINES

IN FULL VARIETY.

Sizes varying from 30 to 2000 H P.



Preferred above all others by the United States and Brush Electric Lighting Co.'s for regularity of speed and economy.

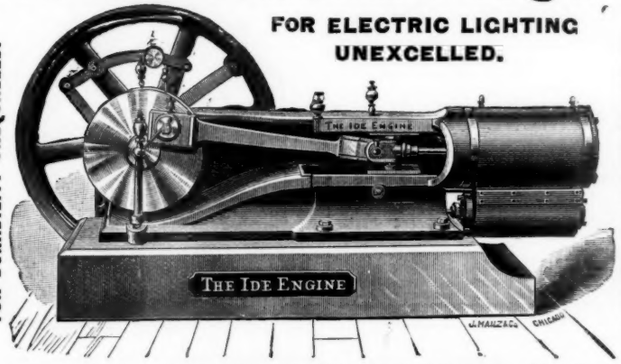
Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound

SEND FOR CIRCULAR.

The IDE Automatic Engine.

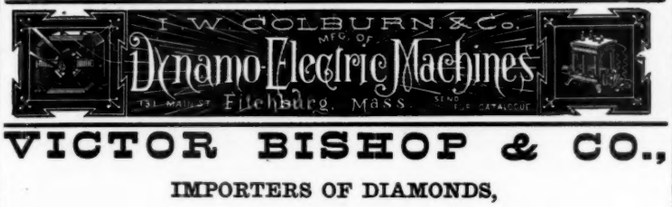
FOR ELECTRIC LIGHTING UNEXCELLED.

FOR DURABILITY UNEQUALLED.



HIGHEST ECONOMY GUARANTEED.

A. L. IDE, SPRINGFIELD, ILLINOIS, U. S. A.



VICTOR BISHOP & CO.,

IMPORTERS OF DIAMONDS,

PLATINUM

For all Manufacturing, Chemical, Electrical, Dental, and Laboratory purposes.

Victor Bishop & Co.,

ESTABLISHED 1837. No. 33 MAIDEN LANE, NEW YORK.

A. C. NORTHROP,

Waterbury, Conn.

Iron and Brass Machine Screws

ZINC IN SHEETS AND PLATE FOR ELECTRICAL PURPOSES.

Parts for Telegraph and Telephone Instruments,

MANUFACTURED FROM

Iron, Brass, Steel, or Zinc.

Opportunity to Estimate on patented articles from Sheet Metal, Rod or Brass Castings, respectfully solicited.

H. M. RAYNOR,

No. 25 Bond Street,

New York.

ESTABLISHED 1859.

PLATINUM IN All Forms FOR ALL PURPOSES,

Wholesale and Retail

ESTABLISHED 1864.

WILLIAM A. HARRIS

MANUFACTURER OF

HARRIS-CORLISS

STEAM ENGINES

With Harris' Patented Improvements

ALSO

Light and Heavy Iron Castings

PROVIDENCE, R. I.

Send for copy "Engineers' and Steam Users' Manual," by John W. Hill, M. E. Price, $1.25.

"OTTO" GAS ENGINE

OVER 10,000 IN USE.

Started Instantly by a Match. When Stopped all Expense Ceases.

Works without boiler, steam, coal, ashes or attendance. Successfully adapted instead of steam power in all industries and offers special advantages for running electrical machinery for Telegraph and Telephone as well as Lighting purposes.

Built in Sizes of 1, 2, 4, 7, 10, 15 & 25 ind. H. P.

SCHLEICHER, SCHUMM & CO.

N. E. cor. 33d & Walnut, Phila.

Branch Office: 214 Randolph Street, Chicago.

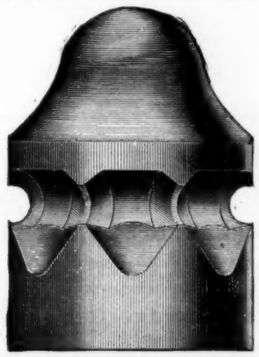
THE CHICAGO INSULATING CO.,

122 LA SALLE ST., CHICAGO, ILL.,

MANUFACTURERS OF

TELEGRAPH, TELEPHONE AND ELECTRIC LIGHT

INSULATORS.



Including **"The Fiske & Mott High Resistance Insulator,"** which, for long lines or wherever high insulation is required, are unequaled. We invite attention to our new "SCREW KNOBS" "COMBINATION HOOKS," as superior to and cheaper than any others. Correspondence solicited.

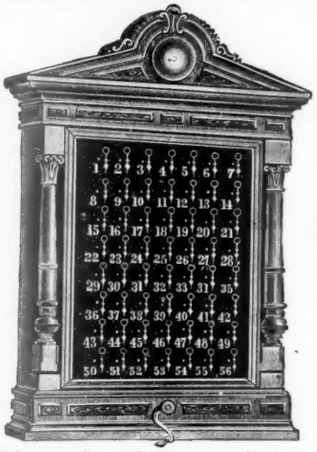
TO INVESTORS.

The KEITH ELECTRIC COMPANY having secured and paid for valuable patents covering a complete system of Electric Lighting, and having demonstrated the economy and reliability of their light, are now prepared to push its introduction with the utmost energy. For this purpose a limited amount of the stock is offered for sale at $20 per share. For full particulars address,

* AUSTIN GALLAGHER,
DREXEL BUILDING,
Cor. Wall and Broad Sts., N. Y.

* Refers to Proprietors of the ELECTRICAL REVIEW.

PARTRICK & CARTER'S



Electric Annunciator.

(PATENTED FEB. 16, 1875.)

We guarantee our Annunciator to be the most SIMPLE, durable and reliable apparatus in the market. NO DROPS or other COMPLICATED MECHANISM to get out of order, and NECESSITATING CONSTANT REPAIRS. We have furnished some of the largest and finest hotels in the country with our Annunciators.

Those wishing Agencies for these Annunciators in unlicensed territory can obtain all information, prices, etc., by addressing us.

Correspondence solicited with all Operators, Managers of Telephone Exchanges and Electric Bell-hangers. Send for Catalogue of Annunciators, Alarms, Electric Bells, etc.

PARTRICK & CARTER, 114 SOUTH 2d ST., PHILADELPHIA, PA.

American Electrical Works

MANUFACTURERS OF

Patent Finished Insulated Electric Wires,

TELEPHONE AND ELECTRIC CORDAGE,

ELECTRIC LIGHT WIRE

MAGNET WIRE,

PATENT RUBBER COVERED WIRE, OFFICE AND ANNUNCIATOR WIRE, LEAD-ENCASED WIRE ANTI-INDUCTION AERIAL AND UNDERGROUND CABLES ETC., ETC.

OFFICE AND FACTORY:

No. 67 STEWART STREET,
PROVIDENCE, R. I.

EUGENE F. PHILLIPS, President.
W. H. SAWYER, Secretary and Electrician.

UNION ELECTRIC MN'F'G CO.,

Factory, 7 & 9 Bond Street,

NEW YORK,

Manufactures all kinds of

Telegraph, Gold and Stock,

DISTRICT & DOMESTIC APPARATUS.

Students and Inspectors Portable Wheatstone Bridge and Galvanometer Combined.

DEALERS IN

ELECTRICAL SUPPLIES

OF EVERY DESCRIPTION,

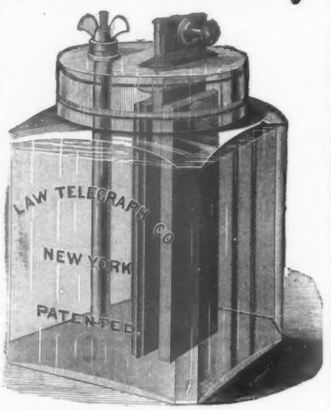
BEST GOODS. LOWEST PRICES.

Lines Equipped with Quadruplex and Duplex Systems (patents protected).

Correspondence Invited.

THE

Law Battery.

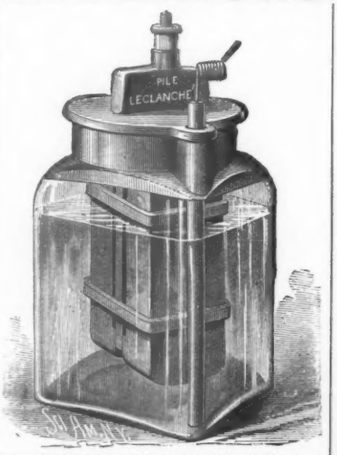


The BEST Open Circuit Battery in the World and the CHEAPEST.

Combines all the advantages of the best of the others, without any of their disadvantages. Thousands sold monthly. Send for circular. Manufactured and sold by the

LAW TELEGRAPH CO.,
140 Fulton St., New York.

LECLANCHE



Prism Battery, Complete. Size of Jar, 6x4½ inches.

THE GREAT

TELEPHONE BATTERY.

The Standard Open Circuit Battery of the World.

OVER 500,000 CELLS NOW IN USE IN THE UNITED STATES AND 1,000,000 IN EUROPE.

ADOPTED BY ALL THE

Telephone Companies.

THE SIMPLEST, CLEANEST, MOST DURABLE, MOST ECONOMICAL.

Beware of Infringements and Cheap Imitations.

LECLANCHÉ BATTERY CO.

149 W. 18th St., N. Y., or

L. G. TILLOTSON & CO., 5 & 7 Dey St., N. Y.

THE BERGMANN & HAID BATTERY.

The Greatest Open Circuit Battery in the World.

Superior to the Leclanche and all others, for Telephone, Annunciator, Burglar Alarm, and all open circuit work.

Price (complete) $1.20.

Liberal discount to dealers.

Send for descriptive Circular and Price List.

BERGMANN & CO.
Electrical Works,
292, 294, 296 & 298 AVENUE B,
NEW YORK, N. Y.

PAT'D {Oct. 16, 1883. Nov. 20, 1883.

THIRD EDITION NOW READY.

ELECTRICITY

In Theory and Practice,

Or the Elements of Electrical Engineering

BY

Lieut. BRADLEY A. FISKE, U.S.N.

PRICE $2.50.

8vo, Cloth, 180 Illustrations.

Copies sent postpaid by mail, on receipt of price.

D. VAN NOSTRAND, Publisher.

23 Murray and 27 Warren Streets, NEW YORK.

Complete Catalogue of Electrical Books will be sent to any address on application.

PHOSPHOR-BRONZE

TELEPHONE WIRE,

Insulated and Bare.

"Phosphor-Bronze."

Combines High Electrical Conductivity and Resistance to Corrosion with Lightness and Tenacity.

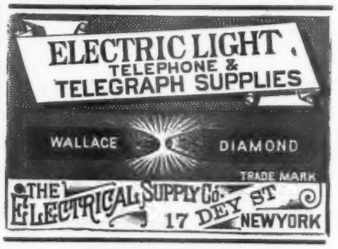
Standard Sizes, 16, 17, and 18, Stubs' Gauge.

ADDRESS;

The Phosphor-Bronze Smelting Co. (limited,)
512 ARCH ST., PHILADELPHIA, PA.

Owners - of - the - United - States - Phosphor-Bronze - Patents.

Sole Manufacturers of Phosphor-Bronze in the United States.



SPIRAL TELEPHONE WIRE.

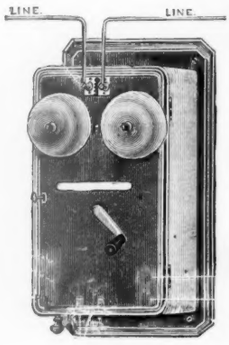
For Long & Short Distance Telephoning

Patents allowed April 24, July 25, 1883.

American Spiral
Telephone Wire Company,

43 Milk Street,

BOSTON, MASS.



Viaduct Manufacturing Co.

OF BALTIMORE.

(Successors to late firm of DAVIS & WATTS.)

A. G. DAVIS, President.

ELECTRICAL GOODS OF EVERY DESCRIPTION.

Telephone, Telegraph, Electric Light and American District Supplies.

SEND FOR ILLUSTRATED CATALOGUE,

MAGNETO SIGNAL BELLS.

NO BATTERY REQUIRED.

$4, to $6, each. Discount on large lots.

THE ELECTRIC STORAGE AND LIGHT CO.

95 Milk St., Boston, Mass.

Organized under the Laws of Massachusetts,

OWN THE PATENTS FOR

Faure's Storage Batteries,

OR

Electrical Energy Accumulators,

FOR

MASSACHUSETTS, RHODE ISLAND AND CONNECTICUT.

THE TROPICAL AMERICAN TELEPHONE CO., (LIMITED.)

SOLE AUTHORIZED EXPORTERS OF

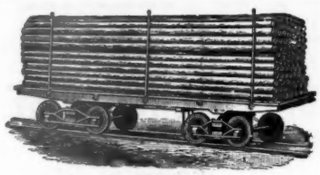
Patented Telephones & Telephonic Apparatus

FROM THE UNITED STATES TO SOUTH AMERICA, CENTRAL AMERICA, MEXICO, AND THE WEST INDIA ISLANDS.

No. 95 Milk Street, Boston, Mass., U. S. A.

THE
TRENTON IRON CO.
MANUFACTURERS OF
GALVANIZED IRON WIRE
OF VARIOUS GRADES FOR
Telegraph and Telephone Lines.

WORKS AND OFFICE AT
TRENTON, NEW JERSEY
NEW YORK OFFICE:
Cooper, Hewitt & Co., 17 Burling Slip.
PHILADELPHIA OFFICE:
21 NORTH FOURTH STREET.

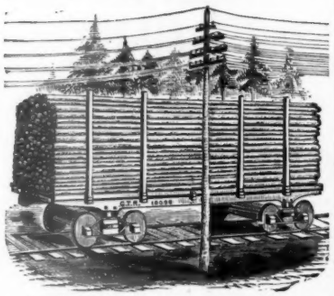


CEDAR
TELEGRAPH POLES
From 25 to 60 Feet in Length.

Seasoned ready for immediate delivery. The Largest and Best Selected Stock in Michigan. We quote prices delivered at any Railroad Station in the United States.

BROWNLEE & CO.
DETROIT, MICH.
[Please mention this paper.]

HANDSOME **POLES** & DURABLE.



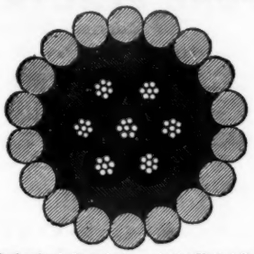
CANADIAN CEDAR POLES, the best in use; live 25 to 35 years; good appearance. Prompt delivery at Buffalo, Black Rock or Suspension Bridge, N.Y. Cheap for spot Cash. Address
HARVEY STAFFORD & CO.,
ACTON, Ont., Canada.

ROYCE & MAREAN,
DEALERS IN
ELECTRICAL APPARATUS,
Telegraph and Telephone Supplies,
No. 1408 Penna. Avenue,
Opp. Willard's Hotel, WASHINGTON, D. C.
Correspondence Solicited.

National Electric Company,
ELECTRICAL SUPPLIES
AND APPARATUS,
1413 G STREET, WASHINGTON, D. C.
Estimates furnished. Correspondence solicited.

W. R. POPE & CO.
Corner North & Lexington Streets,
BALTIMORE, MD.
Telegraph, Telephone and Electric Light Supplies.
THE BEST OF EVERYTHING
AND AT LOWEST PRICES

The Bishop Gutta-Percha WORKS.
SAMUEL BOARDMAN, Agent.)



Original and only Manufacturers in the United States.
GUTTA-PERCHA INSULATED
Submarine Telegraph Cables,
50 Regular Sizes. One to Ten Conductors.
Subterranean Telegraph Cables.
Hempen-Armored Covered.
Aerial Telegraph Cables,
Lead or Hempen Covered.
ANTI-INDUCTION
Telephone (Lead-Covered) Cables,
as used by the Metropolitan Telephone & Telegraph Co.
Torpedo Cables,
Recommended by the European and South American Governments.
Lead-Covered Cables,
For Canal and Streamlet Crossings.
Gutta-Percha Office Wire, Leading and Connecting Wire,
For Subaqueous Mining and all other Electrical purposes.
Mark 8 Compound Insulated Wire,
For Office, Outdoor, Underground, and Battery Use.
G. P. Office Wire, Cotton-Covered.

ALSO HAVE ALWAYS ON HAND:
Wires of every variety of Insulation,
Magnet Wire, Telephone Flexible Cords, Flexible Elevator Cables, Electric Cordage, Burglar-Alarm and Annunciator Wire, Electric Light Wire, Cordage and Cables, Lead-Covered Wire, and every description of pure Gutta-Percha goods, Gutta-Percha Sheet, for Cable Splices; G. P. Chemical Vessels for Acids, etc.

Agents for Reception of Orders and Sale of Goods:
L. G. TILLOTSON & CO., 5 & 7 Dey St., New York.
WILLIAM HEATON, 503 Chestnut St., Phila.

Thirty-three years' experience has taught us that neither the electrical nor mechanical qualities of either Gutta-Percha or Copper deteriorate by long working or submersion, consequently the best form of a Submarine Telegraph cable will be that in which these conditions were fulfilled.—*Extract from Report on Cables, by Willoughby Smith.*
MANUFACTURED BY
The Bishop Gutta-Percha Works.
Address all communications to
W. W. MARKS, Superintendent,
420, 422, 424 & 426 East 25th St., N. Y.
OFFICE AT THE WORKS.

Rhode Island Telephone and Electric Co.
PROVIDENCE, R. I.,
MANUFACTURERS OF THE
Providence Telephone Switch-Boards,
BRECKENRIDGE JACKS,
Wright Cable Clips,
Howard Safety Appliance,
For protection to telephone subscribers against Lightning or Electric Light currents.
Dealers in Electric Appliances of every description.
Manufacturers and constructors of Lightning Rods upon scientific principles.
Licensees of The Time Telegraph Co. of New York for the New England States. Energetic men with capital wanted to form local plants in territory not yet disposed of.
Correspondence solicited from inventors, or parties having electrical novelties, with a view either to purchase or introduction as agents.

HENRY HOWARD, President.
C. T. HOWARD, Treasurer.
J. W. DUXBURY, Sec'y and Gen. Manager.
F. M. GARDINER, Assistant Manager.

B. W. FRENCH, President. W. C. DEWEY, Treasurer. FRANK F. BULLARD, Gen'l Manager.
PALMER WIRE COMPANY
PALMER, MASSACHUSETTS.

GALVANIZED
Telegraph & Telephone Wire
In Long Lengths, by our Continuous Process, and Pronounced by all Users as Unsurpassed in
QUALITY OF MATERIAL, FINISH AND CONDUCTIVITY.
The quality of all wire shipped by us guaranteed to be equal to the best. Testimonials furnished if desired. Put up in half-mile lengths.
Approximate diameter of Wire drawn by PALMER WIRE GAUGE, in thousandths parts of an inch.

No. 4—.225	No. 7—.177	No. 10—.135	No. 13—.092	No. 16—.063
No. 5—.207	No. 8—.162	No. 11—.120	No. 14—.080	No. 17—.054
No. 6—.192	No. 9—.148	No. 12—.105	No. 15—.072	No. 18—.047

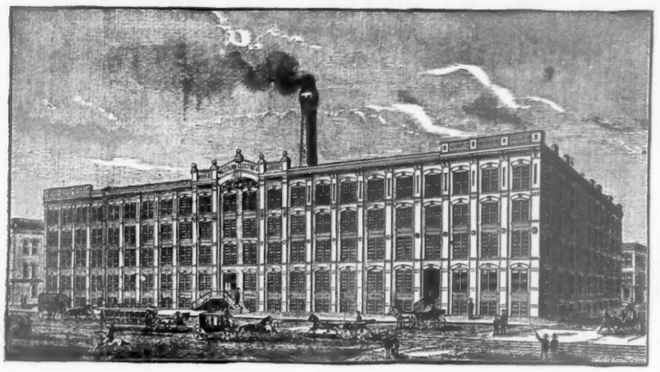
Correspondence Solicited.
New York Office, 15 Courtlandt Street.
FRANK B. KNIGHT, General Agent.

JOHN H. MUEGGE,
IMPORTER OF
PLATINUM.
Manufacturer of all kinds of Chemical Apparatus Crucibles, Vessels, &c., Wire for Electrical Purposes Plate and Wire for Dentists. Scraps Purchased.
No. 91 Liberty St., New York.

BUTLER'S SAFES
FIRE & BURGLAR PROOF.
291 BROADWAY,
NEW YORK.

THE
United States Electric Lighting Co.
SOLE MANUFACTURERS OF
WESTON DYNAMO-ELECTRIC MACHINES
For both Arc and Incandescent Lighting.
WESTON ARC LAMPS, AUTOMATIC REGULATORS,
FIXTURES, CARBONS, &c.
MAXIM INCANDESCENT LAMP.
And all Apparatus necessary for the most COMPLETE, EFFICIENT and RELIABLE SYSTEMS of Electric Arc and Incandescent Lighting.
OFFICE: 59 & 61 LIBERTY ST., NEW YORK.
George W. Hebard, *Pres.* Leonard E. Curtis, *Sec.* Ph. Ferd. Kobbé, *Treas.*
TRUSTEES:
Marcellus Hartley, Edward Weston, Henry B. Hyde, Anson Phelps Stokes,
Walter T. Hatch, John A. Stewart, Charles R. Flint, Henry Day,
Robert B. Minturn, Louis Fitzgerald, George W. Hebard, Leonard E. Curtis,
Thomas H. Hubbard.
SEND FOR CATALOGUE.
Perfect Automatic Regulation in both Systems.

Western Electric Company.



(Chicago Factory, 227 to 251 South Clinton Street.)

MANUFACTURERS OF

TELEGRAPH and TELEPHONE APPARATUS

AND SUPPLIES OF EVERY DESCRIPTION.

Hotel and House Annunciators, Burglar Alarms and Call Bells,
Electro-Mercurial Fire Alarm, Electric Gas-Lighting Apparatus,
Magneto Call Bells, Telephone Exchange Switch Boards, etc.

UNDERGROUND AND AERIAL CABLES.

Correspondence Solicited.

CHICAGO, BOSTON, NEW YORK.

A. G. DAY

MANUFACTURER OF
KERITE INSULATED TELEGRAPH & TELEPHONE

WIRE & CABLES,

OFFICE, 120 BROADWAY, N. Y.—FACTORY, SEYMOUR, CONN.

Anti-Induction Kerite Telephone Cables.

Some of them Two Miles in Length, are in use in several cities, and are found to WORK PERFECTLY for that distance. EMINENT ELECTRICIANS and PRACTICAL TELEGRAPHISTS commend and recognize the Kerite Insulation as superior to all others. At the Centennial Exhibition at Philadelphia, Sir William Thomson, the eminent Electrician and Scientist, awarded to the KERITE INSULATED WIRE AND CABLES

A DIPLOMA

FOR "EXCELLENCE OF THE INSULATION AND DURABILITY OF THE INSULATOR."

GENERAL AGENT:

CLARK B. HOTCHKISS,—120 BROADWAY, NEW YORK.

THE BAXTER ELECTRIC LIGHT CO.

Is prepared to negotiate for New Plants, Complete.

THE BAXTER
IMPROVEMENT IN

ELECTRIC LAMPS

IS THE

Greatest Invention in Arc Lighting yet made.

Efficient, Reliable and More Economical than any other Lamp in the World, and can be applied to any System. SAVES FROM ONE-HALF TO THREE-QUARTERS THE COST OF CARBONS.

For terms for territory and cost of Baxter attachment, address:

THE BAXTER ELECTRIC LIGHT COMPANY,
MILLS BUILDING,
NEW YORK.

The Keystone Electric Co. of Philadelphia, Agents for Pennsylvania.

THE ANSONIA BRASS & COPPER CO.,

MANUFACTURERS OF

PURE ELECTRIC COPPER WIRE,

For Magnets, Telephones, Electric Light, &c.,
Patented Fire-Proof Electric Light Line Wire,
PATENTED FIRE & WEATHER PROOF ELECTRIC LIGHT LINE WIRE,
Patented Paragon Line Wire—Fire Proof, Water Proof,
"ACME" BRONZE TELEGRAPH AND TELEPHONE WIRE,
Wrought Metal Gongs for Annunciators,
Telephones, &c., Zinc Rods, Battery Copper, &c.,

WAREROOMS:
19 AND 21 CLIFF STREET, NEW YORK CITY.
Factories, Ansonia, Conn.

HOLMES, BOOTH & HAYDENS,

TRADE MARK.

MANUFACTURERS OF

"TENAX" COPPER LINE WIRE

—FOR—

Telegraph and Telephone.

ELECTRIC LIGHT WIRE,

Magnet Wire, Patent "K K" Copper and Iron Wire,
Red and White Iron Line Wire.

NEW YORK, BOSTON AND PHILADELPHIA.
FACTORIES, WATERBURY, CONN.

BRIDGEPORT BRASS CO.,

BRIDGEPORT, CONN.,
INCORPORATED 1865.

BRASS, COPPER AND GERMAN SILVER

WIRE AND ROLLING MILLS,

Bare and Insulated Copper Wire for Electric Conductors a specialty.

SOLE AGENTS FOR THE

BRIDGEPORT ELECTRIC MFG. CO.

AUTOMATIC
QUICK ACTING ENGINE.

SELLING AGENTS:

JARVIS ENGINEERING CO.,
61 Oliver St., Boston.
POND ENGINEERING CO.,
St. Louis, Mo.
J. F. RANDALL,
Warren, Ohio.
JOHN R. MAEKLE,
Detroit, Mich.
H. B. SMITH MACHINE CO.,
925 Market St., Phil. Pa.
T. W. ANDERSON,
Houston, Texas.
MIJNSSEN & CO.,
Amsterdam, Holland.

M. F. MOORE, Gen. Agt.
15 CORTLANDT ST., NEW YORK.

THE ELECTRICAL SUPPLY CO.
MANUFACTURERS OF

Insulated Wire

OF EVERY DESCRIPTION.

(Factory of the Electrical Supply Co. at Ansonia, Ct.)

ELECTRIC LIGHT,
TELEPHONE AND
TELEGRAPH SUPPLIES.

Warehouse: 17 DEY ST., NEW YORK.

ALFRED F. MOORE,

MANUFACTURER OF

Insulated Wire,

—FOR—

Telephone, Telegraph and Electric Light,
OFFICE, LINE,
—AND—
ANNUNCIATOR WIRE,
Magnet Wire and Flexible Cordage,

200 & 202 N. THIRD ST.,
PHILADELPHIA, PA.